DANA

Instruction Manual

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MODEL 3800A/3860A DIGITAL MULTIMETER

Publication

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MODEL 3800A/3860A

DIGITAL MULTIMETER

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SECTION 1

GENERAL DESCRIPTION

1.1 GENERAL.

The DANA Series 3800A DMM is a versatile, 3-digit instrument featuring Auto Polarity, high-normal and common mode rejection with high accuracy and stability. The 3800A Series consists of the two models shown in figure 1.1: The 3800A and the 3860A.

The 3800A provides full multimeter capability, measuring AC on four ranges, DC on five ranges, Ohms on six ranges and DC current on six ranges (current shunts are permanently wired in the instrument). The 3860A is used when dc and ohms functions only are desired.

1.2 OPTIONS.

Both the 3800A and the 3860A are available equipped with the following options:

Electrical output (OP-1) for providing non-isolated, 1-2-4-8 binary coded decimal (BCD) data for driving a printer or other digital recorder;

Rack mounting flanges (D P/N 403350) for converting the DMM from a bench top to a rack mounted instrument;

Export transformer (3800A-E, 3860A-E) which allows modification for use on power lines of 100, 120, 200, 220, or 240 volts ac, 50 Hz to 70 Hz.

1.3 MECHANICAL DESCRIPTION.

The basic DMM is designed as a bench top instrument and comes equipped with a bail handle to simplify carrying. The Bail handle rotates 270° and may be used as a "Kickstand" for easy viewing and control access. All components of the basic instrument including the power supply are mounted on a single printed circuit board and housed in a high-impact plastic case. Access to the interior of

Figure 1.1 - 3800A/3860A

the instrument for calibration and maintenance is made by removing five screws on the back panel.

1.4 ELECTRICAL DESCRIPTION.

The Series 3800A utilizes the Dual-slope integration method of Analog to Digital Conversion. This technique minimizes the number of components for increased reliability and lower cost while having inherent advantages of stability and noise rejection. The circuitry which performs the analog to digital conversion is shown in the simplified block diagram of figure 1.2. The purpose of the circuitry is to convert the input (a dc level) into a proportional time period. This is done by first converting the input into an equivalent negative current which is applied to a capacitor (C1) for a set time period. This produces the characteristic linear ramp (signal integration period) shown in the figure. At the end of this time period, the voltage across C1 is proportional to the input voltage. A precise positive reference current is then applied to C1, discharging the capacitor at a fixed rate (and producing the other "leg" of the dual slope ramp as shown in the figure). The time required to discharge the capacitor is directly dependent on the voltage appearing across the capacitor at the end of the signal integration period. The reference integration period, representing the value of the input level, is measured and displayed by the digital portion of the instrument.

1.5 SPECIFICATIONS.

Specifications are shown in table 1.1.

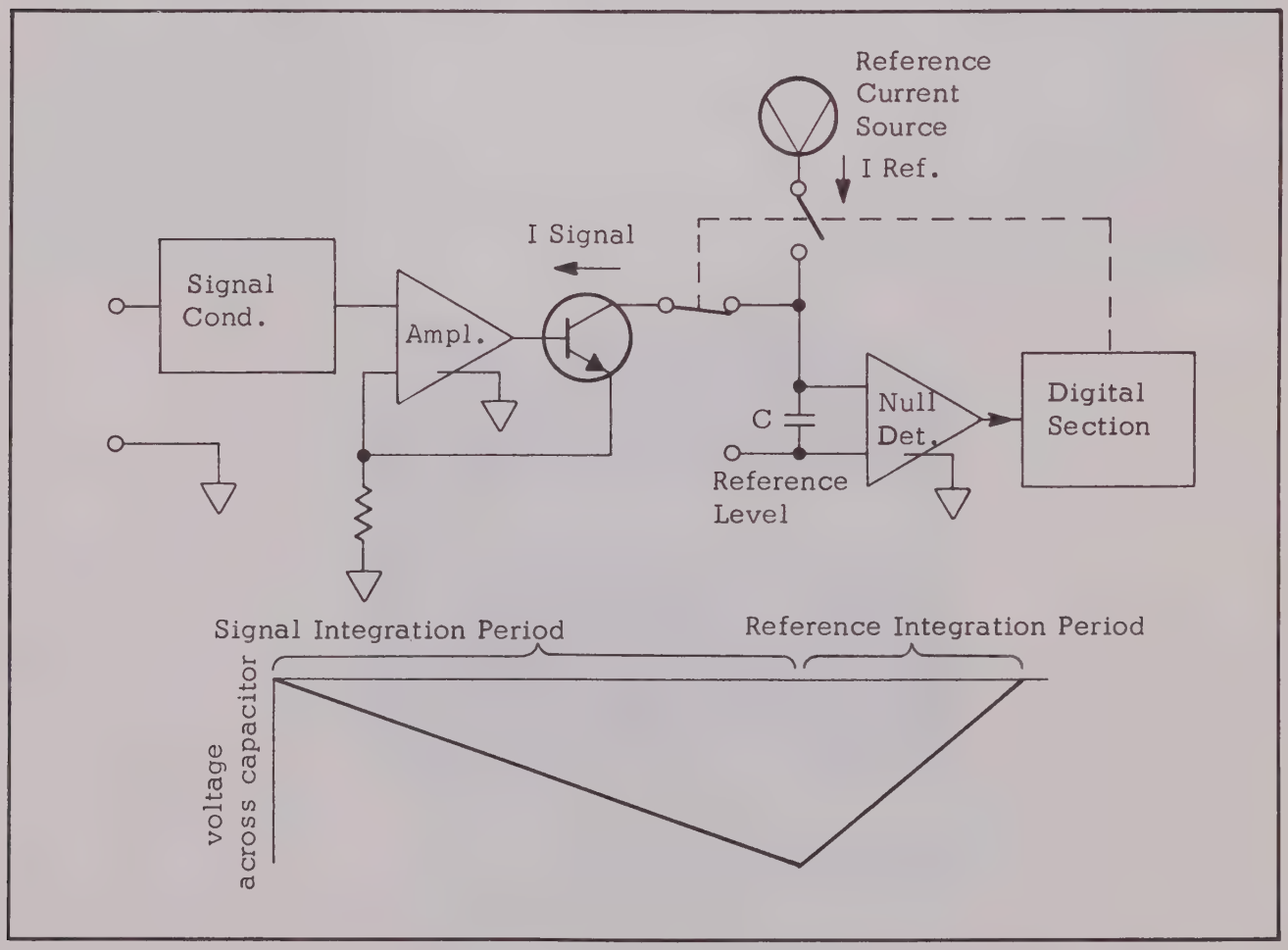


Figure 1.2 - Simplified Block Diagram

TABLE 1.1 - DANA SERIES 3800A SPECIFICATIONS

DC VOLTAGE	
Full Scale Ranges:	± 200 mV, ± 2, ± 20, ± 200, and ± 2000V (1000V maximum)
Resolution:	100 μV on 200 mV range
Polarity:	Automatic bi-polar
Accuracy:	90 days, 15° to 35°C ± (0.1% of reading + .05 of f.s.)
Stability:	6 months ± 0.1% of reading
Input Resistance:	2V range 1000 megohms minimum 200 mV range 100 megohms minimum 20, 200, and 2000V ranges 10 megohms
Normal Mode Noise Rejection:	60 dB, 59Hz and above at 18 dB/octave to a minimum of 70 dB up to 100 KHz
Common Mode Noise Rejection:	At or near 60 Hz (1000 ohms, either lead) 100 dB (100,000 to 1)
Response Time:	< 1.5 seconds to .1% f.s. on 20V range, <1 second on all other ranges
Maximum Voltage Rating:	1000 volts (any range)
AC VOLTAGE (3800A only)	
Full Scale Ranges:	2, 20, 200, and 2000V RMS (500V maximum)
Resolution:	1 mV RMS on the 2 volt range
Accuracy:	90 days, 15° to 35°C 40 Hz to 1 kHz ± (0.3% of reading + .05% of f.s.) 1 kHz to 10 kHz ± (0.4% of reading + .05% of f.s.) 10 kHz to 100 kHz ± (0.9% of reading + .05% of f.s.)
Input Resistance:	2 megohms on 2V range 1 megohm on all other ranges
Shunt Capacitance:	100 pF
Common Mode Noise Rejection:	At or near 60 Hz (1000 ohms, common lead) 60 dB (1000 to 1)
Response Time:	< 2 seconds to full accuracy
Maximum Voltage Rating (Any Range):	500 volts RMS to 10 kHz, decreasing to 150 volts at 100 kHz
RESISTANCE	
Full Scale Ranges:	200 ohms, 2, 20, 200, 2000 kilohms and 20 megohms
Resolution:	100 milliohms on the 200 ohms range
Accuracy:	90 days, 15° to 35°C 2, 20, 200 kilohm ranges ± (0.2% of reading + .05% of f.s.)

TABLE 1.1 (Continued)

Accuracy: (Continued)	200 ohms, 2 megohm ranges ± (0.4% of reading + .05% of f.s.)	
	20 megohm range ± (1.0% of reading + .05% of f.s.)	
Response Time:	200 ohm, 2, 20, and 200 kilohm ranges 〈1 second	
	2000 kilohm range 〈2 seconds	
	20 megohm range 〈12 seconds	
Current Through Unknowns:	200 ohm range	10 milliamperes
	2 kilohm range	1 milliamperes
	20 kilohm range	100 microamperes
	200 kilohm range	10 microamperes
	2000 kilohm range	1 micorampere
	20 megohm range	0.1 microampere
Fault Voltage:	200, 2000 kilohm, 20 megohm ranges	500 volts dc or RMS ac
	2, 20 kilohm range	125 volts dc or RMS ac
	200 ohm range	70 volts dc or RMS ac

DC CURRENT (3800A only)

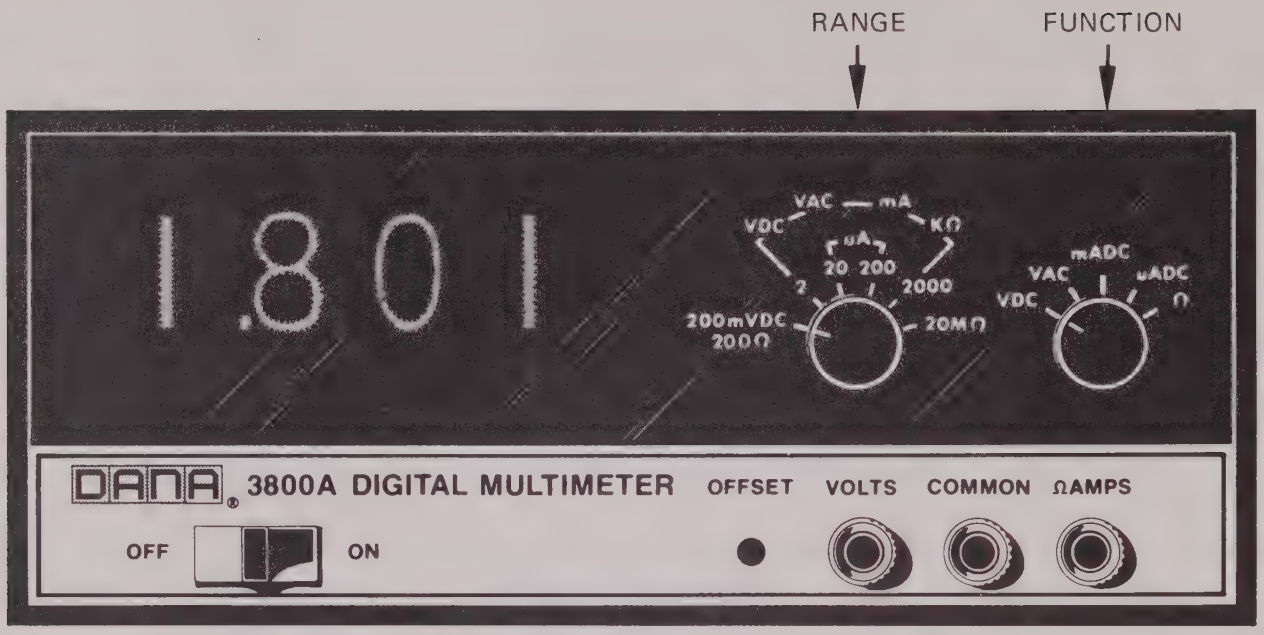
Full Scale Ranges:	20 and 200 μA, 2, 20, 200, and 2000 mA	
Resolution:	10 nA on 20 μA range	
Accuracy:	90 days, 15° to 35°C 20 and 200 μA, 2, 20, 200 mA ranges ± (0.2% of reading + .05% of f.s.)	
	2000 mA range ± (0.4% of reading + .05% of f.s.)	
Shunt Values:	20, 200 μA	10 kilohms ± 0.1%
	2, 20 mA	100 ohms ± 0.1%
	200, 2000 mA	1 ohm ± 0.1%
Voltage Drop: (At Full Scale)	2000 mA, 20 mA, 200 μA ranges 2 volts	
	200 mA, 2 mA, 20 μA ranges 0.2 volts	
Fault Current:	200, 2000 mA ranges	2.2 amps
	2, 20 mA ranges	70 mA
	20, 200 μA ranges	7 mA

GENERAL

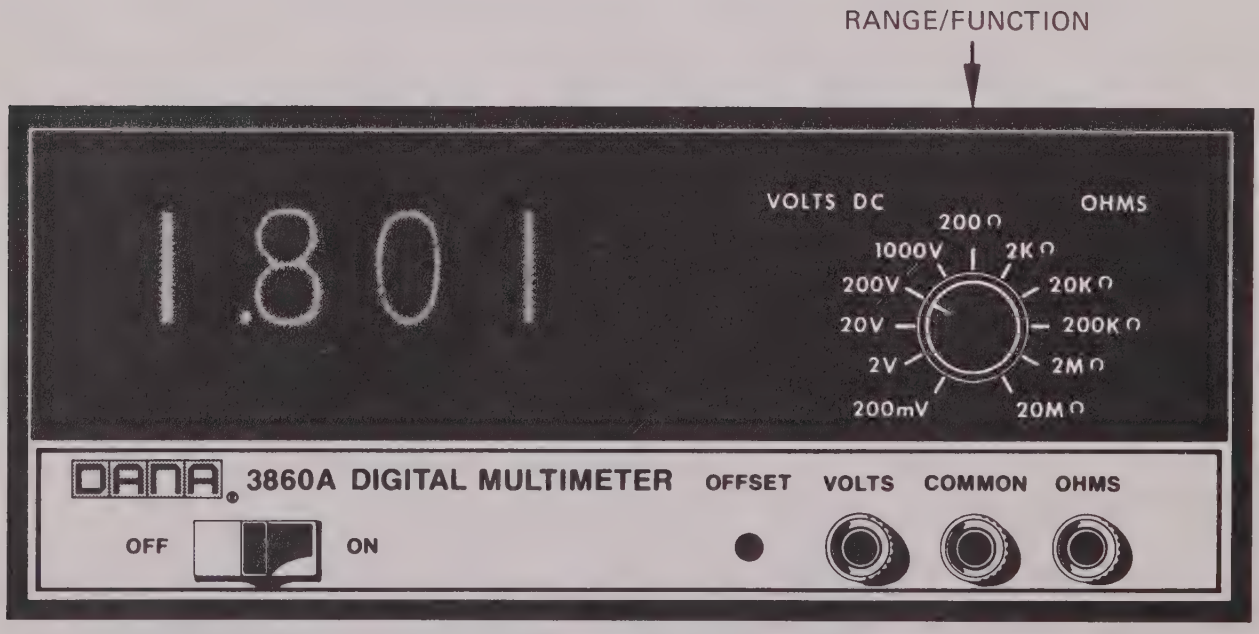
Digitizing Time:	8 ms maximum
Maximum Common Mode Voltage:	250V peak ac or dc
Maximum Power Requirement:	10 watts, 105-125 volts, 50 to 70 Hz
Operating Temperature:	15° to 35°C to full accuracy
Warmup:	10 minutes to full accuracy

TABLE 1.1 (Continued)

GENERAL (Continued)	
Dimensions:	3-½ x 8-½ x 11-¼ inches
Weight:	6 pounds (approx.) net, 8 pounds (approx.) shipping
Guarantee:	12 months, faulty workmanship or component failure
Reading Rate:	4 per second



3800A



3860A

Figure 2.1 Controls

SPECIAL NOTE

The shipping carton and its internal support structure have been scientifically designed for maximum protection of the instrument. Dana recommends saving the carton and contents for use in future reshipping of the instrument. Alternate packing methods, such as plastic foam blocks and loose packing material, may prove to be insufficient for maximum protection and result in damage during shipment.

If reshipping is required and the original carton is not available, special packing instructions can be obtained from Dana Labs' Product Service Department.

SECTION 2

INSTALLATION AND OPERATION

2.1 UNPACKING AND INSPECTION.

The Series 3800A DMM is secured by four-molded, plastic-foam forms and packaged in a double-walled cardboard carton for shipment. The plastic forms hold the DMM securely in the carton and absorb any reasonable external shock normally encountered in transit. Prior to unpacking, examine the exterior of the shipping carton for any signs of damage. Carefully remove the DMM from the carton and inspect the exterior of the instrument for any signs of damage. If damage is found, notify the carrier immediately.

2.2 POWER CONNECTIONS.

A standard eight-foot, three-wire, power cable is permanently attached to the instrument.

2.3 INPUT/OUTPUT CONNECTIONS.

Signal input binding posts are located on the front panel of the instrument. Connections to these terminals is made with a standard "banana" plug. Input connections are made as described in the paragraph titled OPERATION, in this section. A 36-pin connector with a hood is mounted on the back panel of instruments equipped with the Option 1 digital output. Pin locations for this connector are covered in Section 3. Instruments designated by a "Dash 1" (-1) following the model number are equipped with a duplicate set of input binding posts on the rear panel of the instrument.

2.4 CONTROLS.

The location of the front panel controls for each model is shown in figure 2.1. The following descriptions cover the operation of both instruments. Differences in operation are covered in the text.

2.5 POWER SWITCH.

The power switch is a two position slide switch. The ON position applies power to the instrument which immediately begins taking readings at a rate of four per second. The OFF position removes power to all portions of the instrument.

2.6 OFFSET.

The offset is a flat-blade screwdriver adjusted control used to zero the instrument readout. This control may also be used to adjust out unwanted levels from the signal source. Instructions for the use of this control are covered in the paragraph titled FRONT PANEL ZERO, in this section.

2.7 RANGE CONTROL (3800A ONLY).

The range control is a six position switch that selects ranges from 0.2 to 20,000. Inscriptions on the panel and in table 2.1 define which ranges can be used for particular functions.

2.8 FUNCTION CONTROL (3800A ONLY).

The function control is a five position switch that selects the type of measurement required. The positions are:

VDC - Selected for dc voltage measurements, with full scale ranges of from 0.2 to 2000 volts (1000 volts max.).

VAC - Selected for ac voltage measurements, with full scale ranges of from 2 to 2000 volts (500 volts max.).

MADC - Selected for dc current measurements, with full scale ranges of from 2 to 2000 milliamps.

μADC - Selected for dc current measurements, with full scale ranges of 20 and 200 microamps.

OHMS - Selected for resistance measurements, with full scale ranges of 200 Ohms to 20 megohms.

Table 2.1 - Available Ranges

DC	200 mV	2	20	200	2000	
AC	–	2	20	200	2000	–
MA	–	2	20	200	2000	–
μA	–	–	20	200	–	–
OHMS	200	2K	20K	200K	2000K	20 Meg

2.9 FUNCTION/RANGE CONTROL (3860A ONLY).

The function-range control is an eleven position switch that selects VDC on five ranges or OHMS on six ranges.

2.10 INPUT CONNECTION.

Input to the DMM are made through three terminals located on the front panel as shown in figure 2.1. These consist of a red VOLTS terminal, a black COMMON terminal and a white OHMS/AMP terminal (on the 3860A, the white terminal is for ohms only). Shown in figure 2.2 are the proper configurations for connecting this instrument to various signal sources.

2.11 OPERATION.

The instrument is designed for the simplest possible level of operation. Once the instrument has been connected to the power line and to the signal source in accordance with the instructions, the

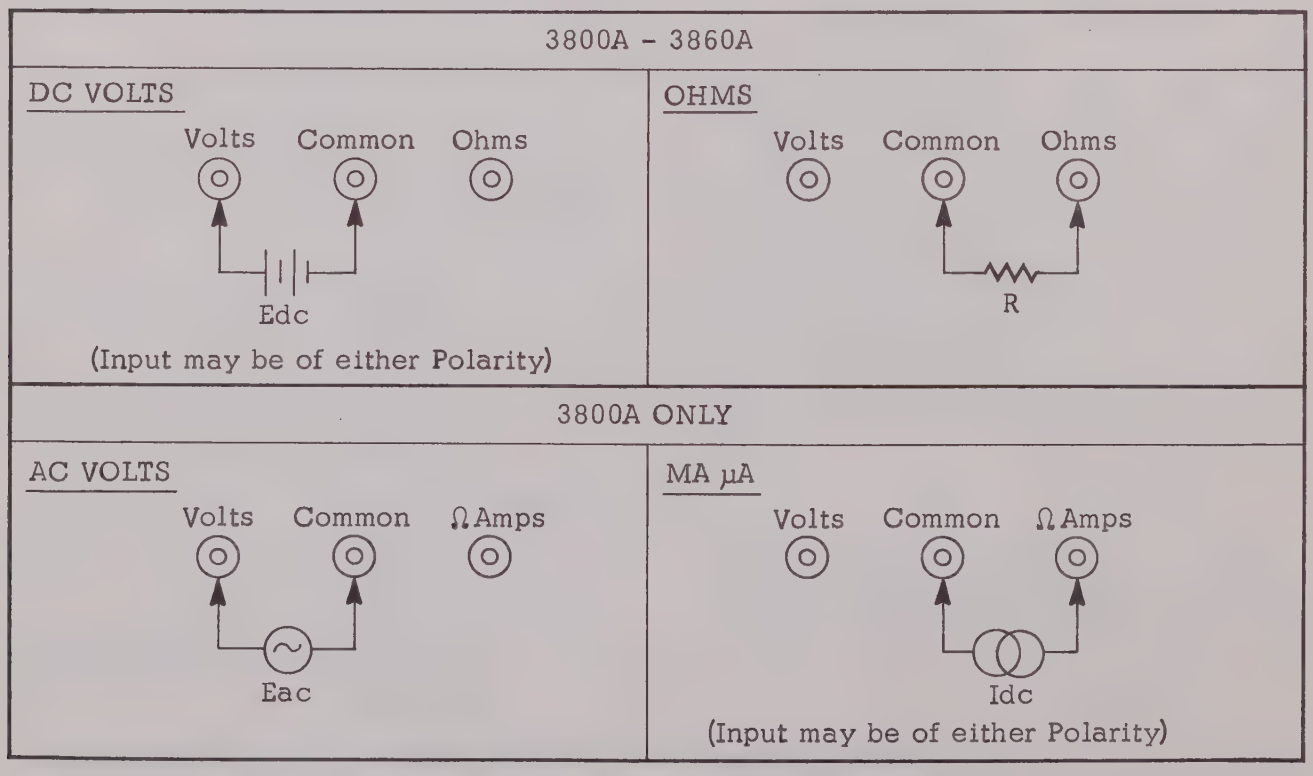


Figure 2.2 - Signal Input

operation can make all the required measurements by setting the front panel controls to the indicated positions.

2.12 FRONT PANEL ZERO.

To eliminate minor offsets, set up the DMM to measure 200 millivolts. Connect a jumper across the VOLTS (red) and COMMON (black) terminals. Adjust the OFFSET potentiometer for a display of 000 with the + and — polarity sign indicators appearing at a 50-50 ratio.

2.13 EXPORT TRANSFORMER.

Instruments designated 3800A-E or 3860A-E are equipped with a special transformer and jumper matrix, allowing the user to adapt the instrument for operation on various line voltages. In figure 2.3 are shown the proper jumper placement on the power matrix board for each line voltage. The matrix board assembly No. 410540 is mounted directly to the power transformer.

CAUTION

Do not exceed the following overloads:

DC	± 1000 volts all ranges
AC	500 volts AC RMS or DC
OHMS	70 volts AC RMS or DC on the 200 ohm range
	125 volts AC RMS or DC on the 2K and 20 Kohm ranges
	500 volts AC RMS or DC on the 200K, 2000K, and 20 Megohm ranges
CURRENT	2.2 amps on the 200 and 2000 MA ranges
	70 MA on the 2 and 20 MA ranges
	7 MA on the 20 and 200 μA ranges

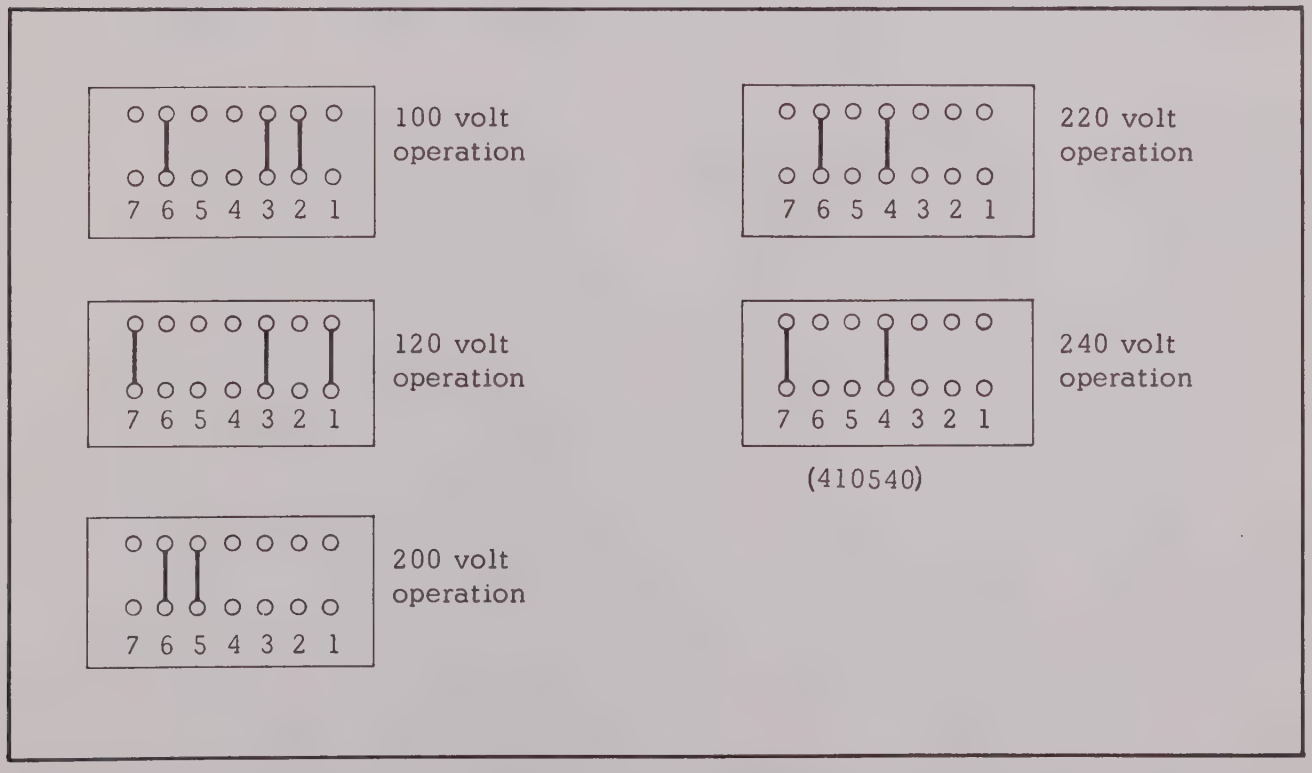


Figure 2.3 - Line Voltage Taps

SECTION 3

ELECTRICAL OUTPUT

3.1 GENERAL.

The Option 1 electrical output transforms the readout, range, and polarity data into binary form for operating printers and other digitally operated equipment. The output of the Option 1 is non-isolated; equipment having floating inputs therefore, should be used with the option to retain the common mode rejection characteristics of the DMM.

3.2 MECHANICAL DESCRIPTION.

All components of the Option 1 electrical output are located on a single printed circuit board which is mounted and hand wired to the DMM circuit board. The output data is taken from a covered edge-connector, mounted to the back panel of the DMM.

3.3 ELECTRICAL DESCRIPTION.

The electrical output is positive true, 1-2-4-8 BCD coding. All outputs, with the exception of the decimal output, are from RTL integrated circuits; the decimal position data is generated by discrete components. A typical output is shown in figure 3.1. Four control lines are provided, two are used for providing external command and two lines indicate when the binary data is available for reading. A simplified drawing of the control logic is shown in figure 3.2. The instrument is inhibited from internally initiating new readings by setting the HOLD line (pin 12) false. Setting HOLD false disables the rate generator. The DMM displays the previous reading as long as the hold line remains true, or until the instrument is externally commanded to take a new reading. The DMM command line (pin A) is held to +4 volts by the pull-up resistor R12. A new reading is externally generated by shunting the DMM Command line to common. A DMM Command is inverted by M1 and sets the Q output of the R-S f/f false, enabling the internally generated 60 Hz line sync pulse to be applied to the DMM rate circuitry. The R-S f/f is reset by the print pulse. The PRINT line goes true following a complete measurement cycle by the DMM and indicates that the data from the electrical output is ready to be recorded. The print line remains true until a new measurement cycle is initiated. The PRINT line is true during the measurement cycle and goes false at its completion. It is used when a negative going print command is required. A new DMM command may be generated any time after PRINT goes true. The DMM will not generate a new reading however until the 60 Hz sync line goes false; thus limiting the maximum externally commanded repetition rate to approximately 17 milliseconds.

3.4 COMMANDS.

External commands may be generated by contact closure or by solid state switching. The HOLD and DVM COMMAND lines operate between +4 volts and common, making the OPTION-1 commands compatible with standard RTL and TTL circuitry.

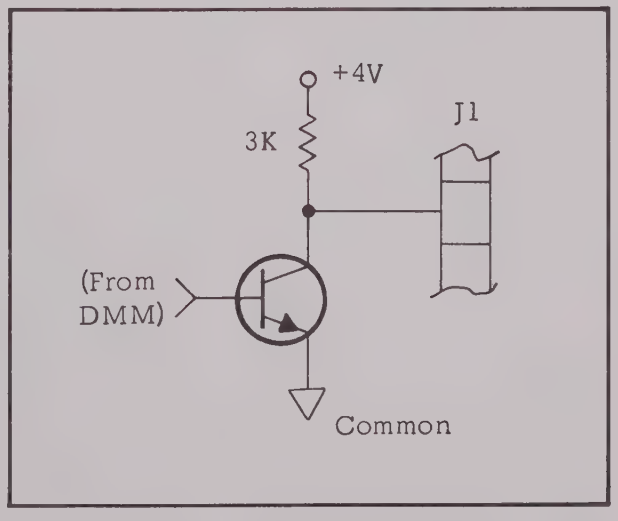


Figure 3.1 - Typical Option Output

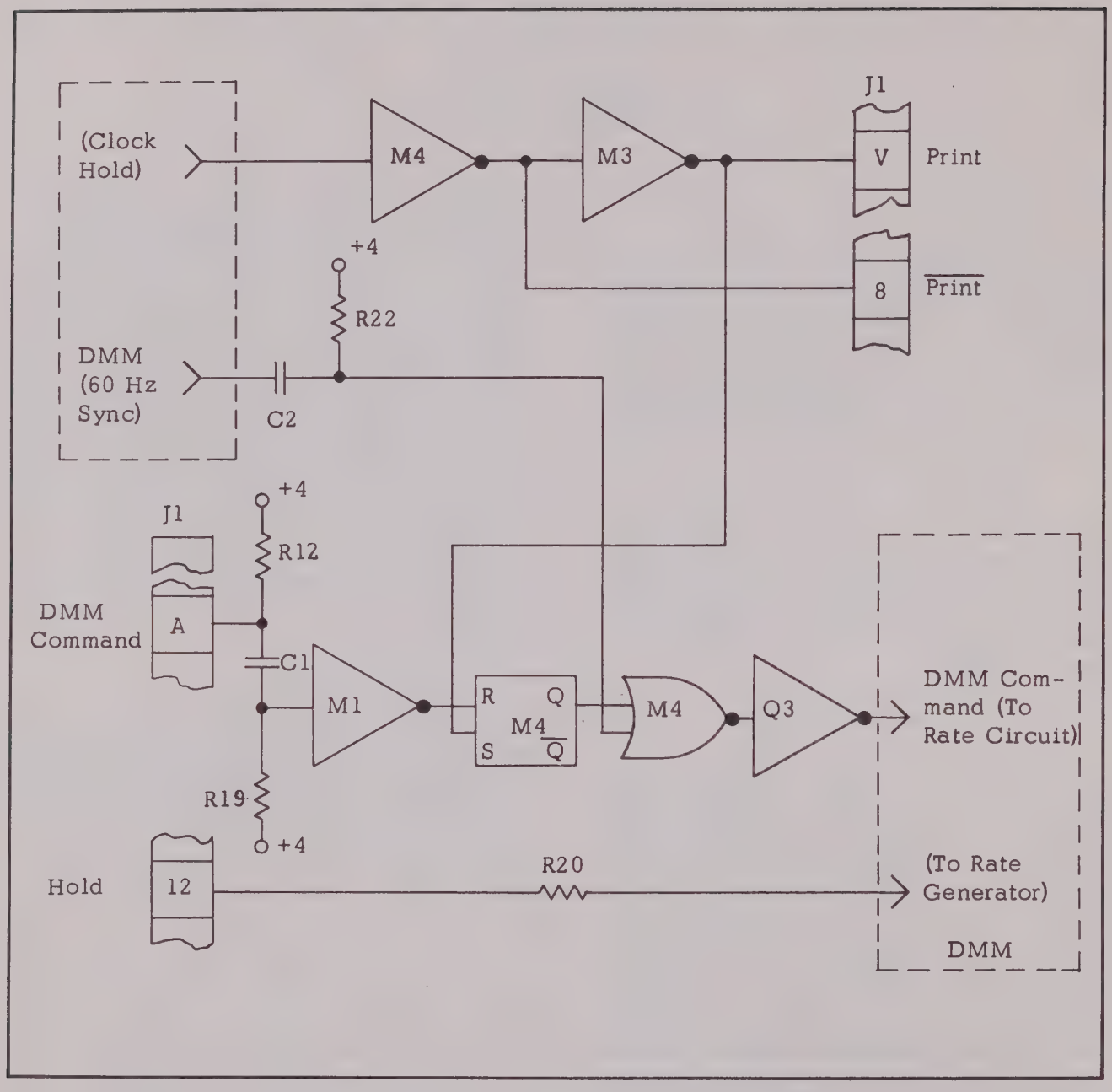


Figure 3.2 - Option Control Logic

Table 3.1 - Electrical Output Timing Diagram

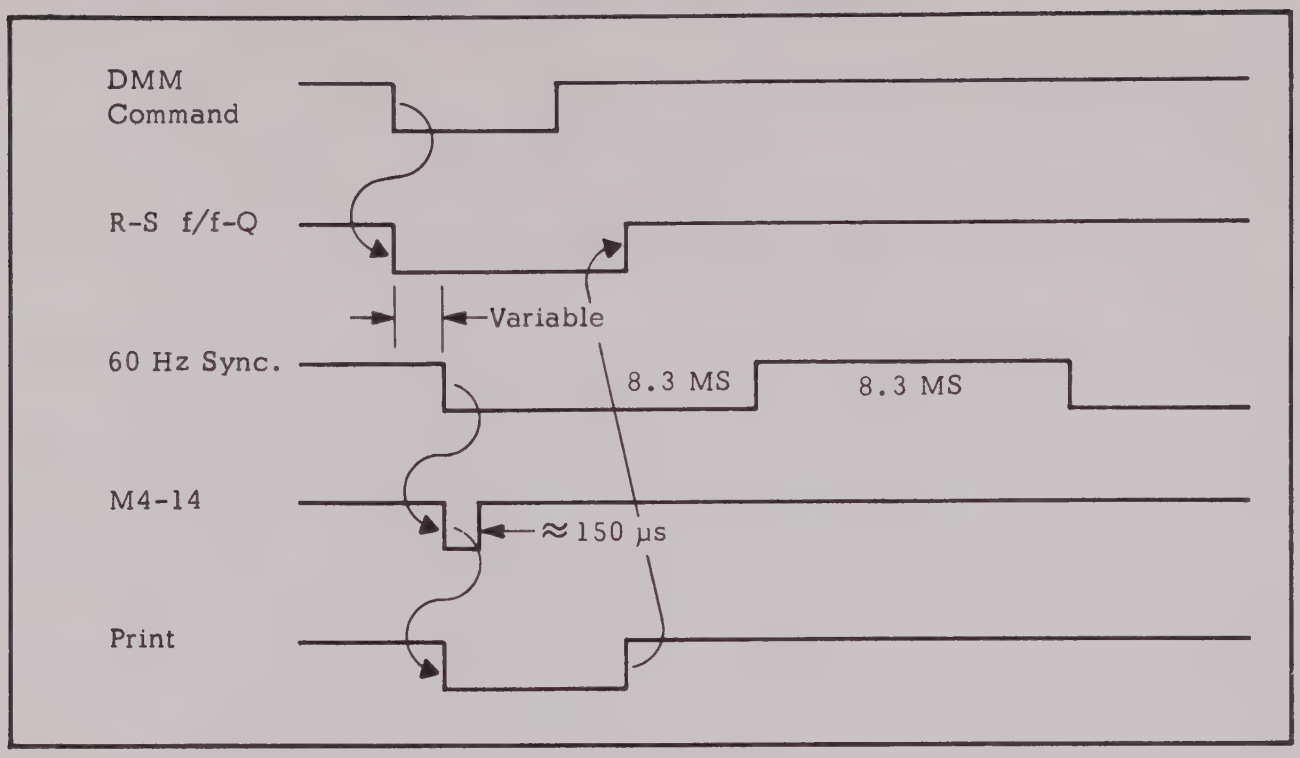


Table 3.2 - Output Connector

	DVM COMMAND	1's				10's				100's				OVERRANGE	POLARITY	OVERLOAD	1 RANGE	PRINT
		1	2	4	8	1	2	4	8	1	2	4	8	1				
J1	A	B	C	D	E	F	H	J	K	L	M	N	P	R	S	T	U	V
PINS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
	FOR OPTIONAL FUNCTION LINES						+4 VOLTS	$\overline{\text{PRINT}}$	10 RANGE	COMMON	100 RANGE	HOLD	FOR OPTIONAL RANGE LINES					

SECTION 4

THEORY OF OPERATION

4.1 GENERAL.

This section describes the operation of the Series 3800A DMM's. The section is divided into two parts, corresponding to the analog and digital divisions of the instruments. The basic operation of these instruments is the same; the differences are confined to the Analog section and noted in the test. At the back of this section is a simplified drawing of the 3860A Analog section (figure 4.25) and a simplified drawing of the Model 3800A (figure 4.26). These drawings, as well as the others appearing in this section, are included to supplement the assembly and schematic drawings located in Section 6.

The Series 3800A DMM uses the dual slope integration method of analog to digital conversion. In this method, a DC input is converted into a proportional, negative current. The value of the current produced is a function only of the absolute value of the input signal, being independent of the polarity of the input signal. The current generated is fed to a capacitor which integrates the current, developing a linearly increasing negative charge as shown in figure 4.1a. The negative cur-

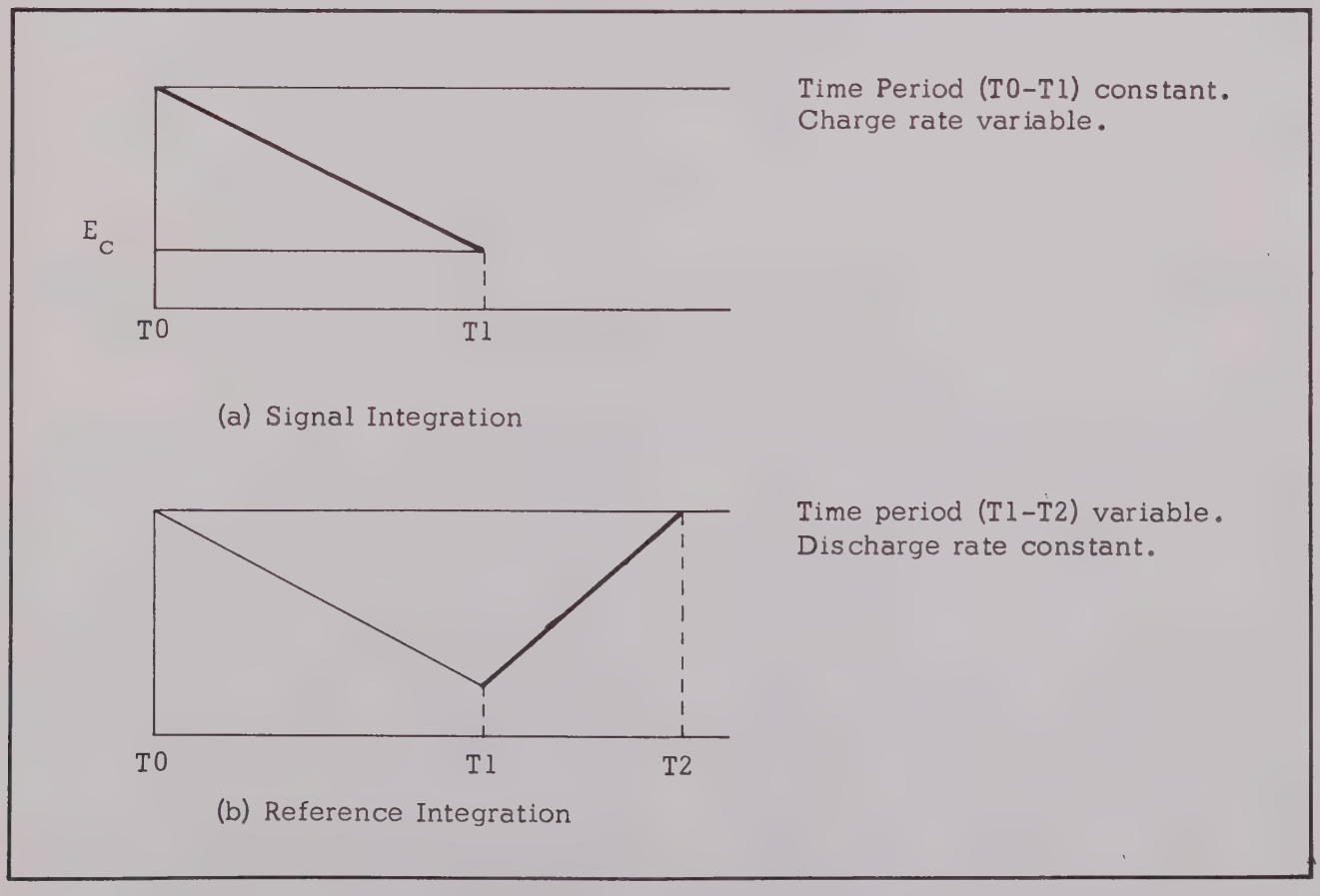


Figure 4.1 - Dual Slope Integration

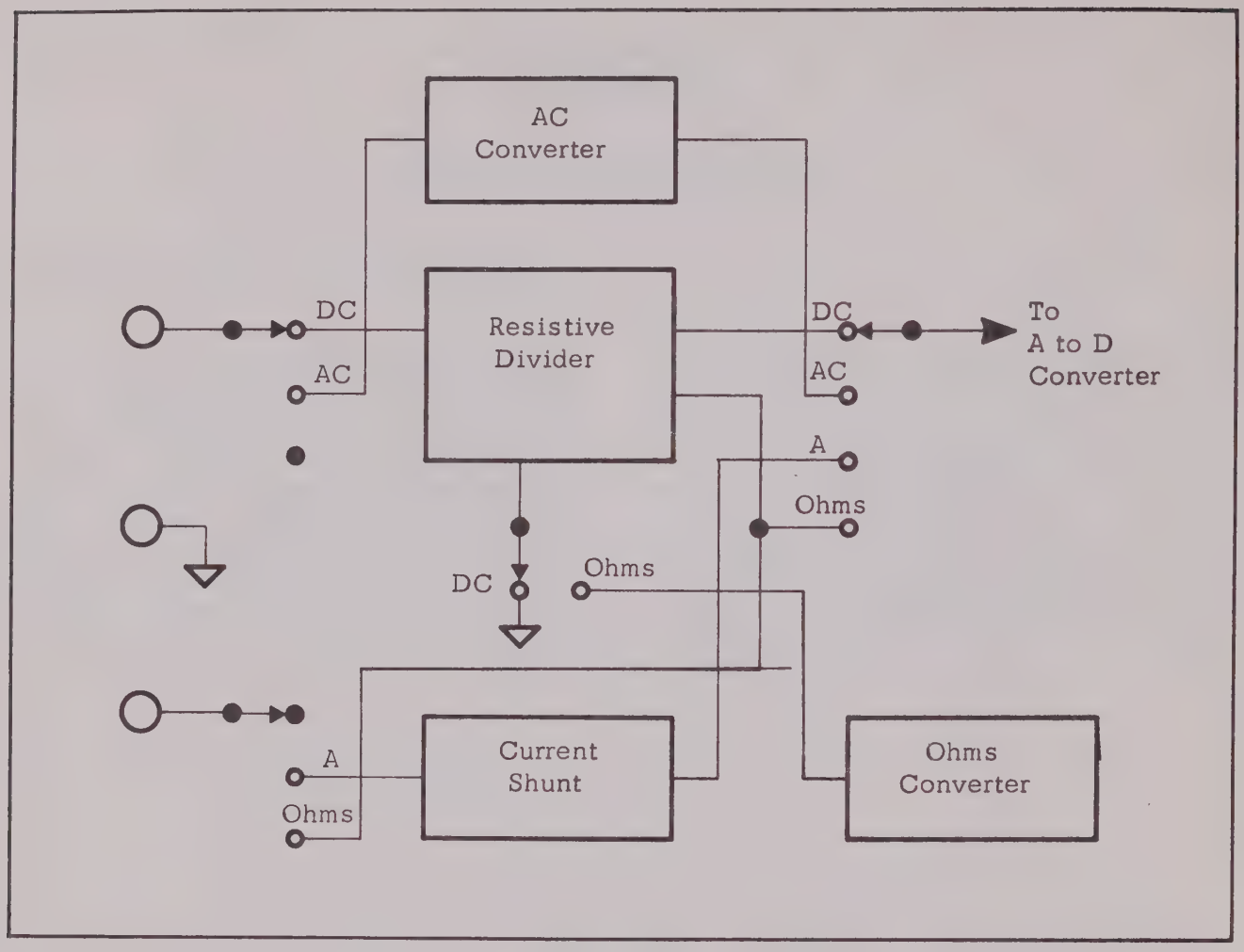


Figure 4.2 - Block Diagram - Signal Conditioning Section (3800A)

rent is applied to the capacitor for a specific time period. The time period (T0-T1) is controlled by a clock driven counter in the digitizing and display portion of the DMM and is equal to 1000 clock cycles. At the completion of this signal integration period (T1), the voltage developed across the integration capacitor represents the value of the input signal. The voltage stored across the capacitor is converted into a proportional time period by replacing the input current with a known, positive, reference current. The positive current causes the voltage across the capacitor to linearly decrease as shown in figure 4.1b. This reference integration period (T1-T2) terminates when the voltage across the capacitor is restored to its original, premeasurement level (T0). The start of the reference integration period (T1) coincides with the counter being set to 0000 and the completion of the period (T2) halts the counter. The reference integration period (T1-T2), which is proportional to the value of the input signal, controls the number of clock cycles registered by the counter. The value of reference current is opposite in polarity but equal in value to the signal current produced by a one volt input. For a one volt input the reference integration period (T1-T2) is equal to the signal integration period (T0-T2) and the counter registers 1000. For a 0.5 volt input the reference integration period is one half as long and the counter registers 500. At the completion of the reference integration period the position of the counter is displayed and numerically represents the value of the input voltage.

4.2 SIGNAL CONDITIONING.

Prior to measuring by the Analog to Digital section of the DMM, the input signal is converted to a maximum DC level of ± 2 volts. The isolator portion of the A to D converter operates at a gain of one or ten depending on the range and function selected (see table 4.1). The scaled input is limited to ± 0.2 when the isolator operates at a gain of 10. The input signal is routed through the function control switch (S1) to the appropriate conditioning circuitry. The conditioned signal is routed again through S1 to the A to D converter.

4.3 DC.

The DC input is applied to the range divider where it is scaled and routed to the A to D converter. On the .2 and 2 volt ranges, no attenuation of the signal takes place. On the 20, 200, and 2000 ranges the input signal is scaled by a factor of .1, .01, and .001 respectively. The additional resolution required for the 2 range is supplied by the isolator.

Table 4.1 - Isolator Gain

Range	DC	AC*	MA*	μA*	Ohms
2	X10				X1
2	X1	X1	X10		X1
20	X1	X1	X1	X10	X1
200	X1	X1	X10	X1	X1
2000	X1	X1	X1		X1
20,000					X1

*3800A only

4.4 AC (Model 3800A ONLY).

The AC Converter, shown simplified in figure 4.3, converts an AC input to an equivalent DC signal. The AC signal is scaled by the AC Converter

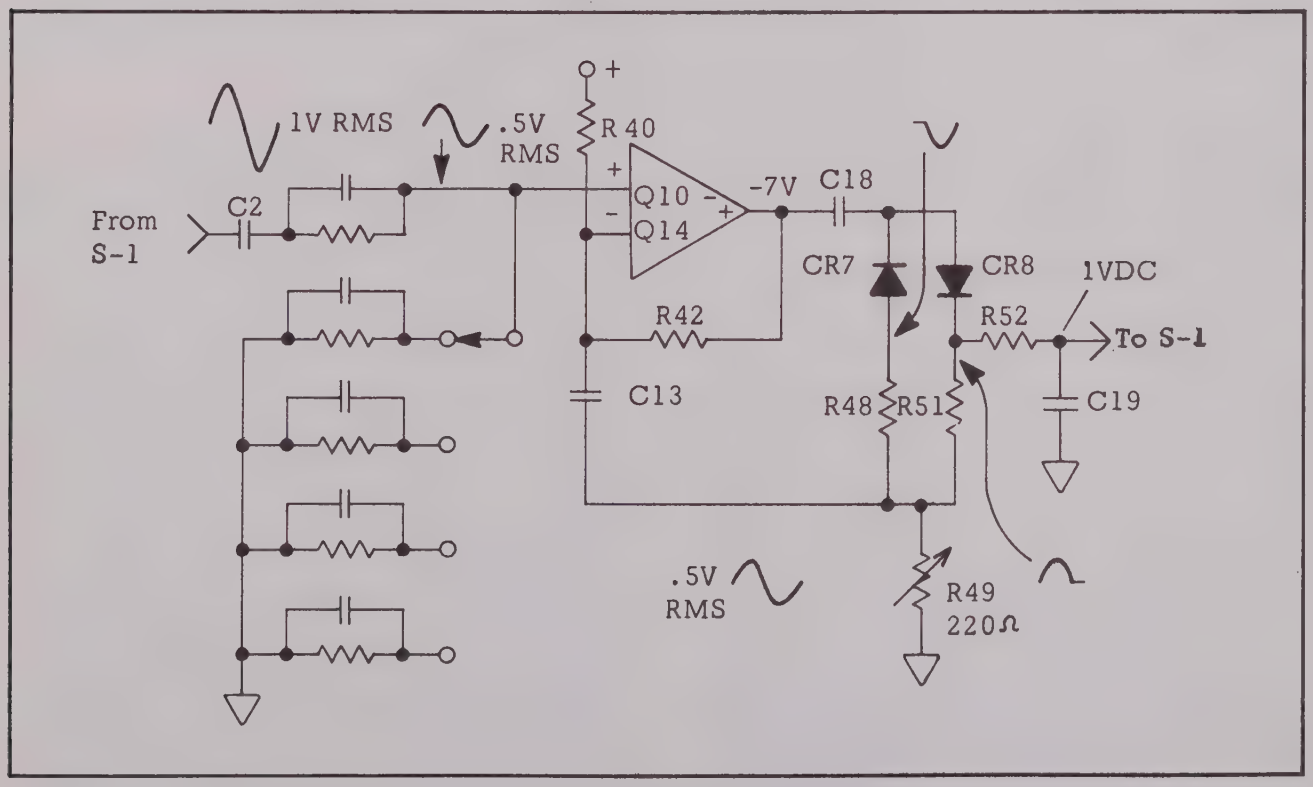


Figure 4.3 - Simplified AC Converter

attenuator by a factor of .5 on the two volt range and by .05, .005, and .0005 on the 20, 200, and 2000 volt ranges respectively. The scaled input is amplified by the potentiometric amplifier consisting of transistors Q10 through Q14. The amplified AC signal is fed through C18 to two polarity dependent feedback paths, CR7 and R48, and CR8 and R51. Each path conducts during one half of the AC signal. The bisected signal is summed across R49 and fed back through capacitor C13 to the reference input of the amplifier. The closed loop gain of the amplifier determined by R48, R49, and R50 is approximately 4.5. The positive half cycle developed across R51 is filtered by R52 and C19 to produce a positive DC equivalent of the AC input. Further filtering is performed on the DC output by the active filter of the Analog to Digital converter section.

4.5 OHMS.

The ohms converter produces a precise current which is fed through the resistance being measured. The resultant voltage drop across the resistor is measured and displayed. The current generated for each range is chosen to produce a two-volt drop across a resistance equal to the range selected. Thus, on the 2K range, a current of 1 milliamp is produced developing a two-volt drop across an input resistance of 2 Kohm. The current produced on each range is given in table 4.2

Table 4.2 - Ohms Converter Current Output

RANGE	CURRENT
200 Ohms	10 MA
2 Kohms	1 MA
20 Kohms	100 μA
200 Kohms	10 μA
2 Megohm	1 μA
20 Megohms	100 na

A simplified diagram of the ohms converter is shown in figure 4.4. The voltage developed across the resistance being measured (Rx) is buffered by a gain of one amplifier. The ohms converter generates a precise voltage (E), referenced to the amplifier output. The voltage is connected to a precise range resistor (Rr) and (Rx), connected in series. Because the voltage (E) follows the voltage developed across (Rx), the voltage impressed across (Rr) is constant, making the current through (Rx) constant. The input resistance of the gain of one amplifier is extremely high. Effectively, therefore, all of the current flowing through (Rr) also flows through (Rx).

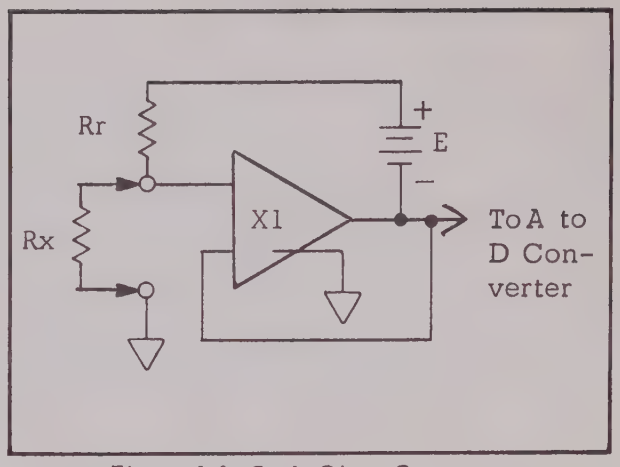


Figure 4.4 - Basic Ohms Converter

For measuring ohms, the converter is used in conjunction with other portions of the DMM circuitry as shown in figure 4.5. The Isolator from the A to D Converter provides the required isolation and precise gain-of-one accuracy for monitoring the voltage drop across resistor Rx. The output of the isolator is buffered by a gain of one amplifier (consisting of transistors Q1 through Q4) on the ohms converter. To the output of the buffer amplifier is connected a network producing two precise voltage outputs. The network consists of a current generator Q5, which is referenced to the DMM's + REFERENCE VOLTAGE, driving a stable 0.5 milliamps through resistors R20 and R22 connected in series. The voltage drop across R22 is +1 volt and is used only on the 20 Meg range. The voltage drop across the two resistors is +5 volts. This level is increased to +10 volts by a gain-of-two amplifier consisting of transistors Q6 through Q9; the 10 volt level is used on all ranges except the 20 Meg range. Both the +1 volt and +10 volt levels float above the DMM input level.

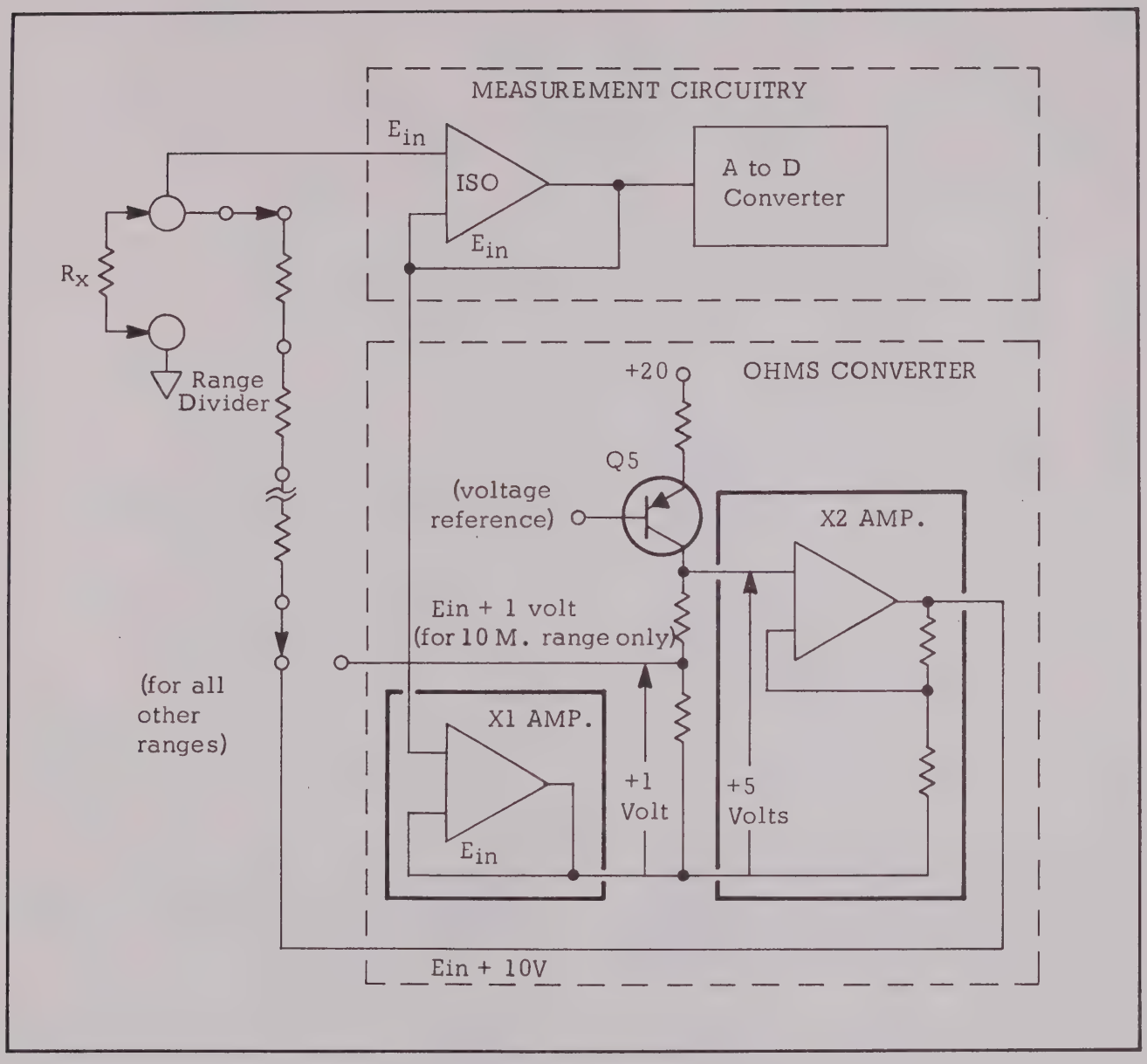
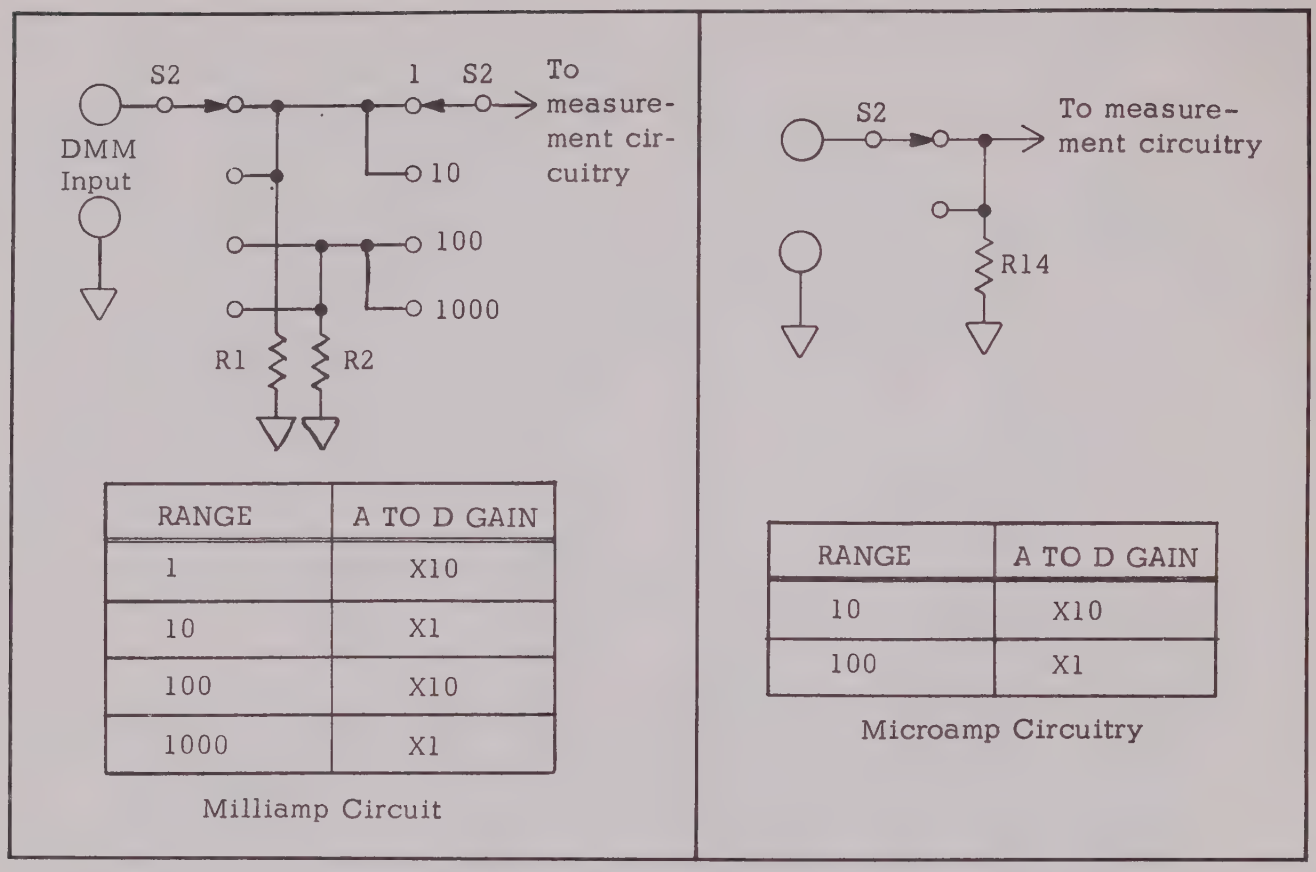


Figure 4.5 - Simplified Ohms Converter

The converter voltage output is routed through a precision, series-divider, consisting of the same resistive string used for the DC range divider. The Range Control selects the amount of resistance (Rr) placed in series with the converter voltage output and Rx, thereby controlling the current produced for each range.

4.6 DC CURRENT (Model 3800A ONLY).

Two current positions, milliamp and microamp, are provided on the Model 3800A DMM. Both functions use internally selected shunts to convert the input current to an equivalent voltage for measurement. As shown in figure 4.6, two shunt resis-



RANGE	A TO D GAIN
1	X10
10	X1
100	X10
1000	X1

Milliamp Circuit

RANGE	A TO D GAIN
10	X10
100	X1

Microamp Circuitry

Figure 4.6 - Simplified DC Current Circuits

tors are used for the milliamp function and one shunt for the microamp function. The gain of the A to D converter is increased to provide the required resolution on the 20 microamp, 2 milliamp and 200 milliamp ranges.

4.7 ANALOG TO DIGITAL CONVERTER.

The Analog to Digital (A to D) converter shown in figure 4.7, converts the input signal to a proportional time period for measurements by the digital section.

4.8 FILTER.

The active bessel-type filter shown simplified in figure 4.8 provides 60 dB of normal mode rejection at or near 60 Hz and consists of transistor Q15 and Q16. The transistors provide a moderately high degree of amplification and through the feedback path (R54, R57, C20, and C22) operate with the source impedance to produce an active 3-pole filter.

4.9 ISOLATOR.

The isolator is a high gain, high input impedance, DC amplifier, consisting of a differential, dual FET (Field Effect Transistor) input stage, driving an integrated circuit amplifier. The isolator (shown in figure 4.9) is operated potentiometrically to provide a closed-loop gain of one. The signal input of the isolator is clamped by transistors Q50 and Q51, connected as diodes, to limit the input signal swing to approximately plus or minus 2.2 volts.

4.10 SIGNAL CURRENT GENERATORS.

The signal current generators operate with the isolator to produce a negative current proportional to the isolator input voltage. One converter oper-

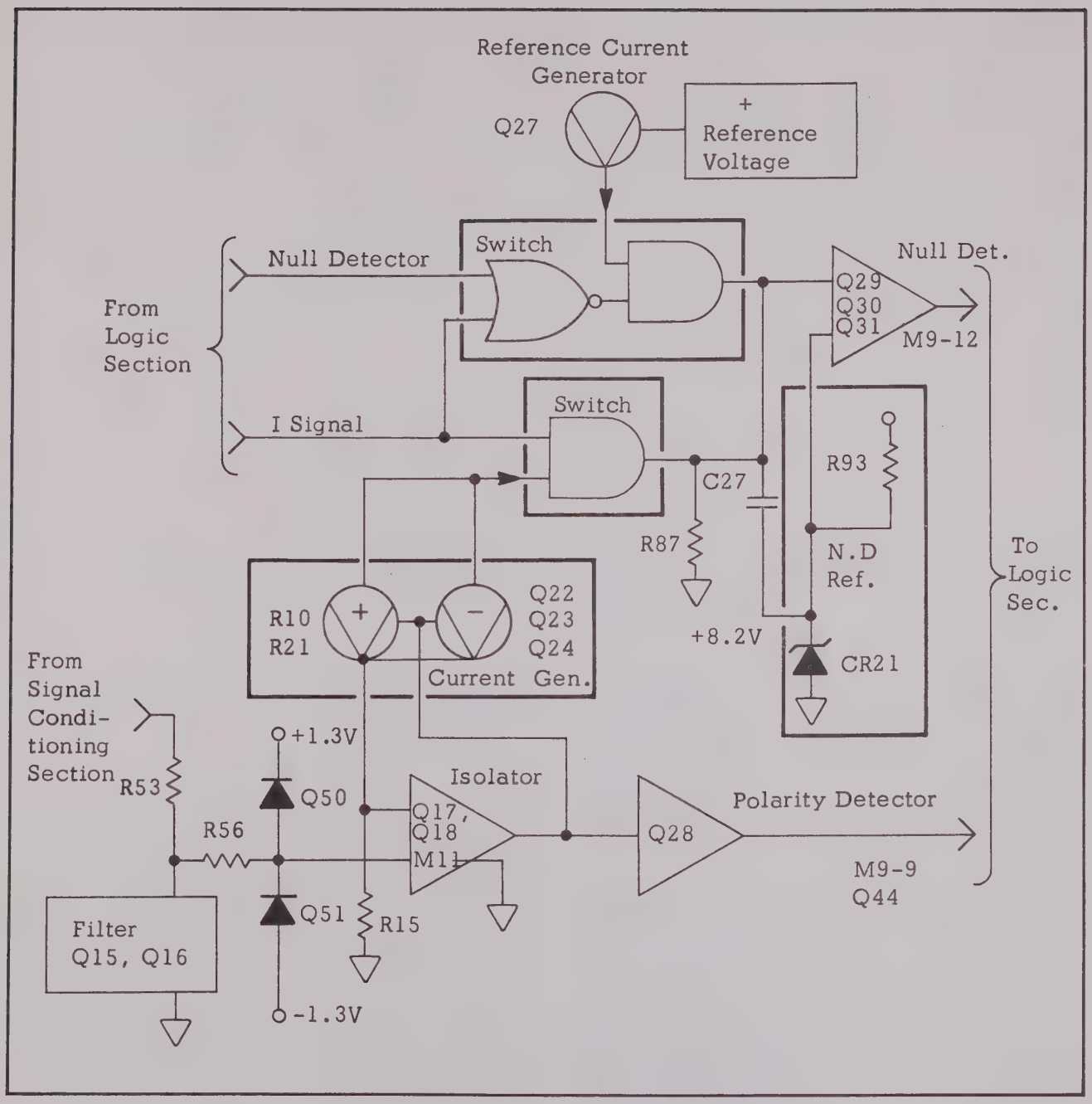


Figure 4.7 - Analog to Digital Converter

ates only during positive inputs and the other only during negative inputs. Shown in figure 4.10 is a simplified schematic of the positive signal current generator. Transistors Q20 and Q21 are connected in a Darlington configuration and may be considered as a single, extremely high beta transistor. A positive level at the input of the isolator produces a high amplified, positive output to the base of Q20-Q21 causing it to conduct. Current flows through the current gain resistor causing a positive I-R voltage drop to develop across the resistor. The network stabilizes when the I-R drop is equal to the

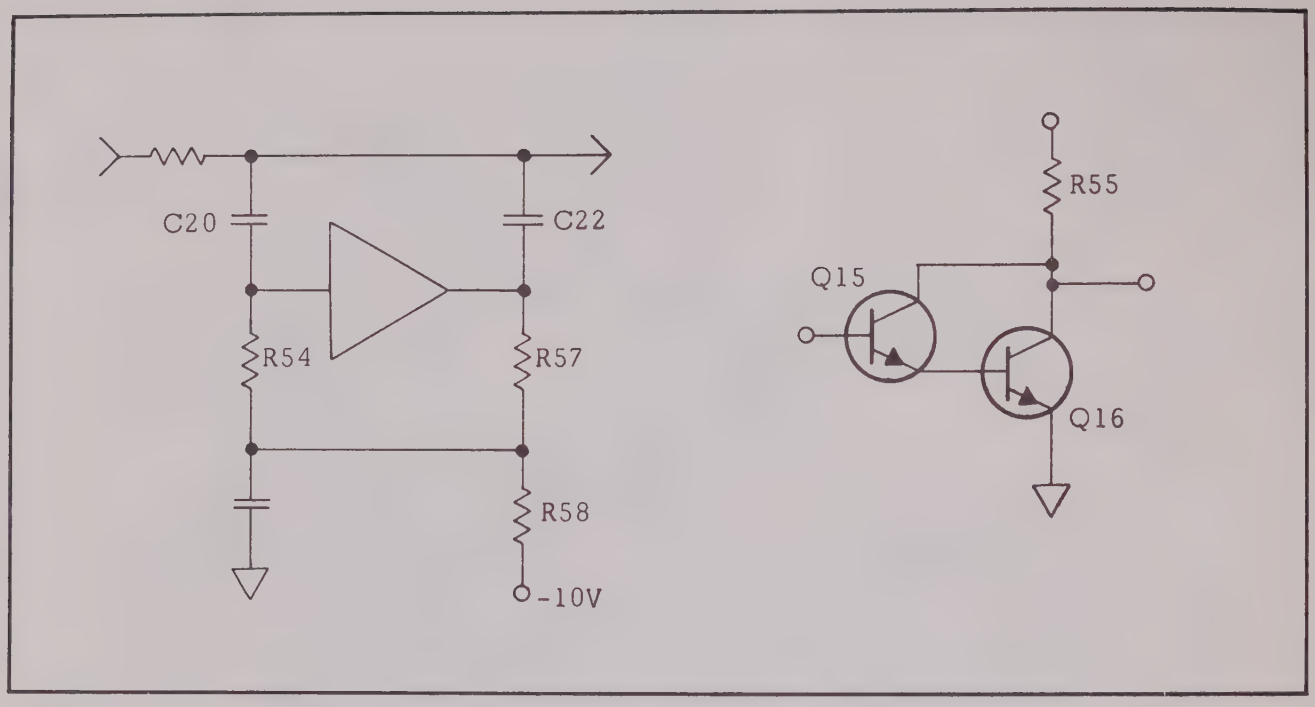


Figure 4.8 - Simplified Filter Schematic

positive isolator input level. The current flowing through the resistor is equal (for all practical purposes) to the current drawn by the Q20-Q21 collector. The current through the current gain resistor varies directly with the isolator input, making the current drain (negative current) from Q20-Q21 directly proportional to the isolator input.

The negative signal current generator shown in figure 4.11 consists of transistors Q22, Q23, and Q24. Transistors Q22 and Q24 have matched characteristics and the emitter circuits are balanced, causing the transistors to draw equal amount of current when conducting. When the input of the isolator is negative, the amplified negative output drives transistor Q23 on, driving current into the bases of Q22 and Q24. The current through Q22 flows also through the gain resistor developing a negative I-R drop across the resistor. The circuitry stabilizes when the negative voltage drop across the gain resistor equals the negative isolator input level. The current drain (negative current) developed by Q24 forms the output of the negative signal current generator and is equal to the current drawn by Q22. It is therefore directly proportional to the negative isolator input.

4.11 GAIN CIRCUIT.

The gain circuit determines the amount of negative current generated by the signal current generators. Normally the gain is determined by R15 (2K) which produces a signal current output of 0.5 milliamps for a $\pm$ 1 volt input to the isolator. On certain function-range combinations R15 is shunted by R19, lowering the combined resistance to 200 ohms. This increases the amount of current produced by the signal current generator by a factor of 10. Function/range combinations are given in table 4.1.

4.12 VOLTAGE REFERENCE SOURCE.

The voltage reference source provides a precise and stable, positive DC level for the reference current generator and ohms converter. The reference is a selected zener diode, biased for a zero temperature coefficient.

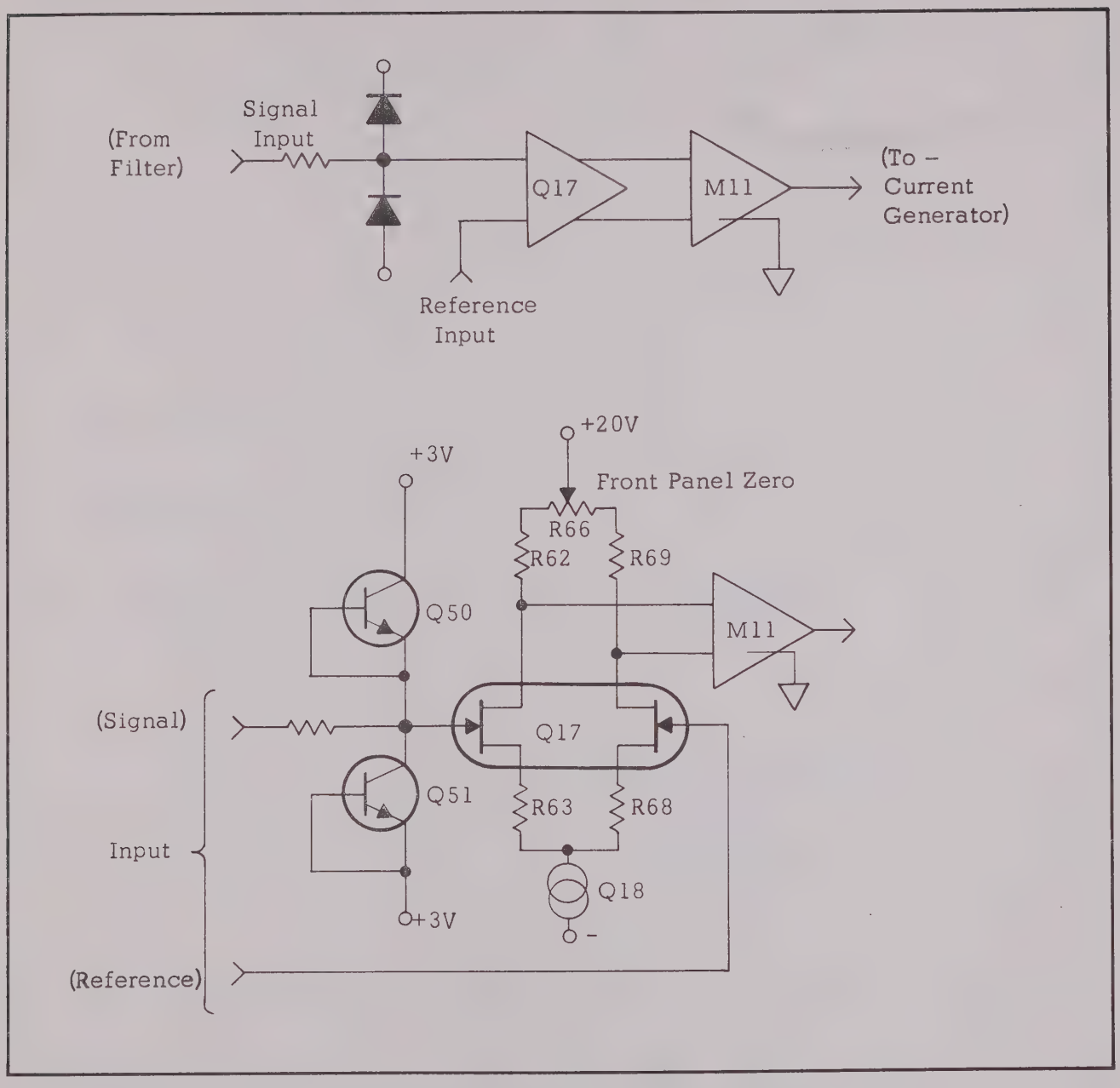


Figure 4.9 - Block Diagram - Isolator/Amplifier

4.13 REFERENCE CURRENT GENERATOR.

The reference current generator (figure 4.12) produces a stable and highly accurate, positive current of 0.5 milliamps. The converter consists of transistor Q27 biased through CR20 to the voltage reference source, and emitter resistors R85, R86. Resistor R85 is set to allow 0.5 milliamps of positive current to flow through Q27. Diode CR20 provides temperature compensation for the reference current generator and ohms converter current generator.

4.14 SIGNAL CURRENT GATE.

The signal current gate controls the flow of current from the signal current generators, routing the flow

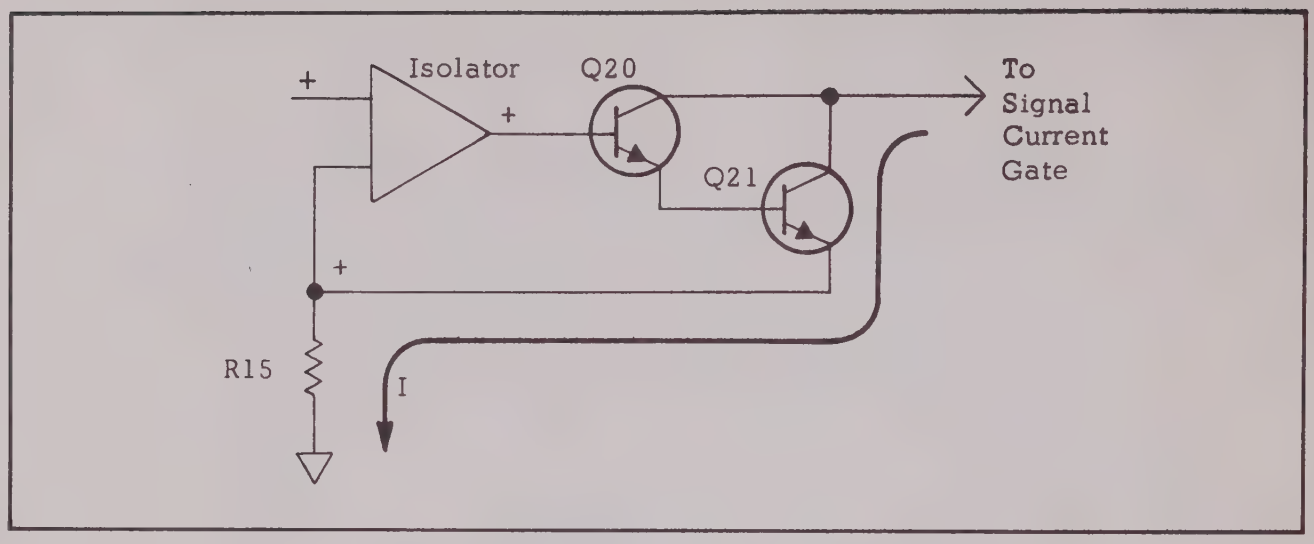


Figure 4.10 - Positive Input Signal Current Generator

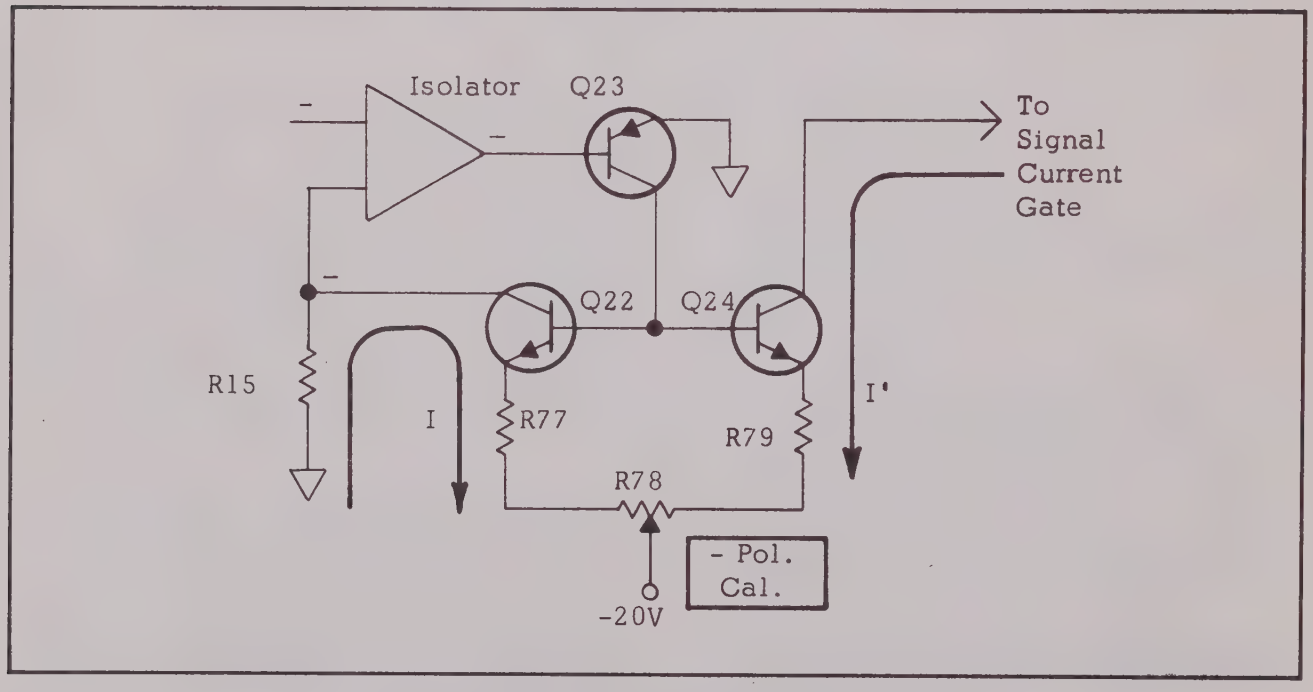


Figure 4.11 - Negative Input Signal Current Generator

to the integrator capacitor or to a positive supply. The signal current gate is operated by I SIGNAL from the logic section of the DMM. The basic circuitry of the gate is shown in figure 4.13a. During the time that I SIGNAL is true, transistor Q19 is turned on, holding gate diode CR15 to approximately +0.2 volts.

When I SIGNAL is false, CR15 is held to +10 volts by zener CR35. The current flow through the gate is shown with Q19 conducting in figure 4.13b. CR15 is back-biased prohibiting current flow; CR17 is forward-biased, allowing all of the current from the signal current generators to flow into the integrator capacitor. With Q19 off, the operation is

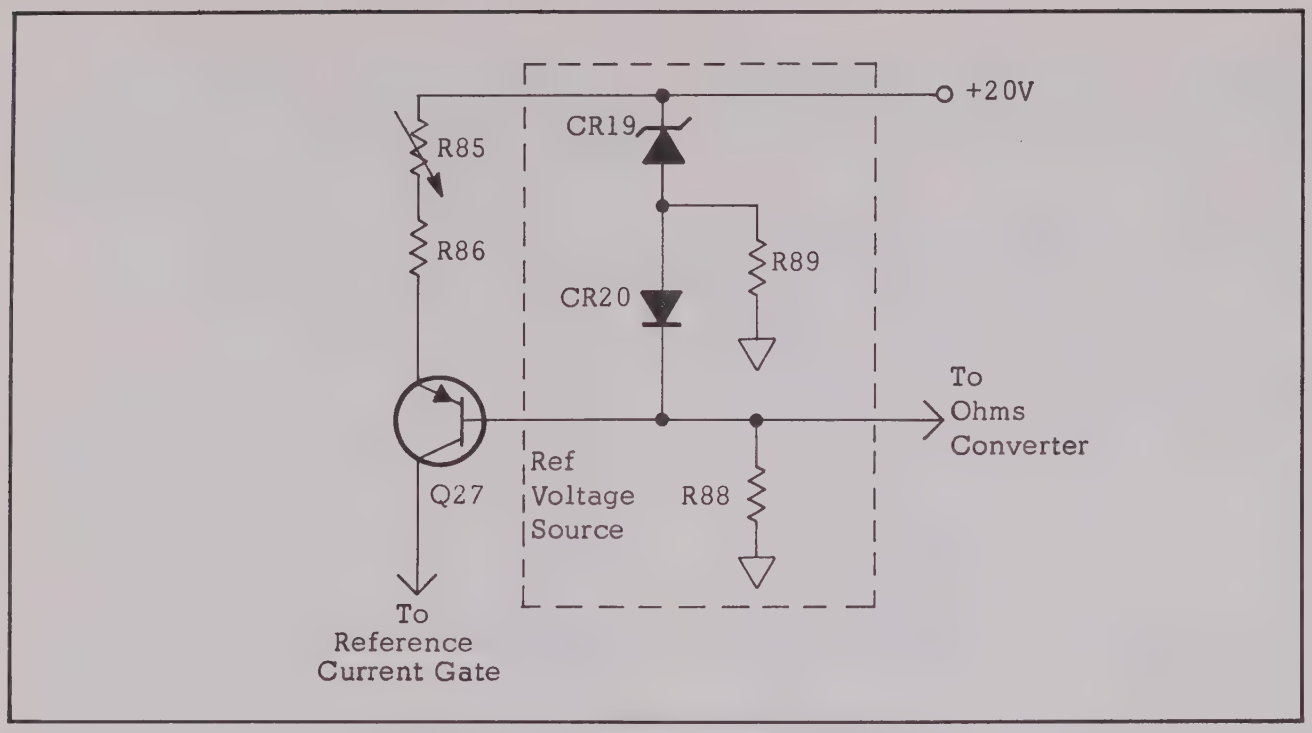


Figure 4.12 - Reference Current Generator

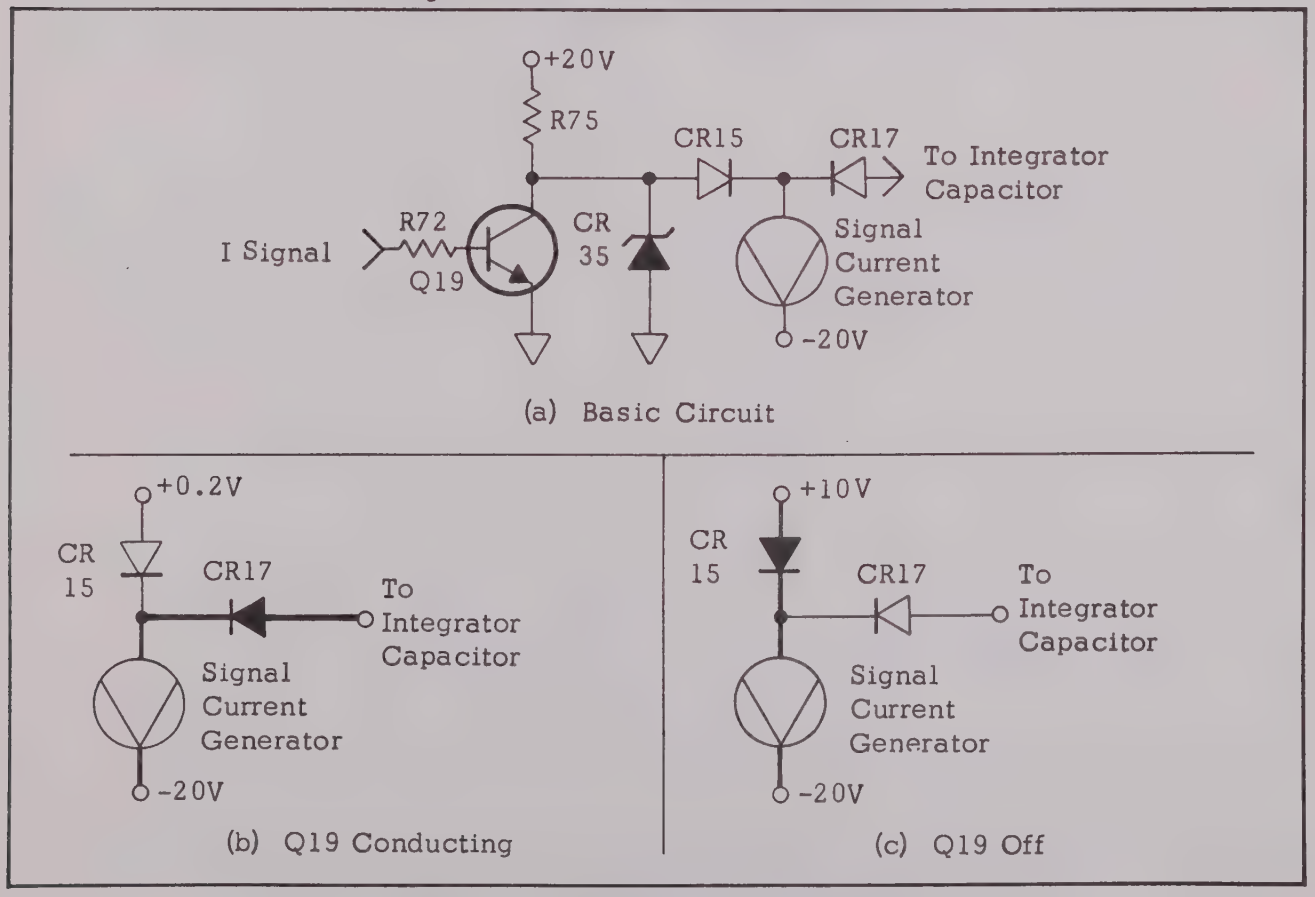


Figure 4.13 - Simplified Signal Gate Circuit

reversed and all of the current flow is through diode CR15.

4.15 REFERENCE CURRENT GATE.

The reference current gate controls the flow of current from the reference current generator, routing the flow to the integrator capacitor or to analog common. The reference current gate is operated by a NOR gate consisting of transistors Q25 and Q26. When input lines NULL DETECTOR and I SIGNAL are both false the nor gate output is +20 volts; when either input line is true the nor gate output is +0.2 volts. Both nor gate input lines are generated in the logic section. The basic circuitry of the gate is shown in figure 4.14a. During the time both NULL DETECTOR and I SIGNAL lines are false the cathode of CR16 is held to +20 volts. When either or both of the input lines are true, the cathode of CR16 is held to +0.2 volts.

Figure 4.14b shows the current flow through the gate with the nor gate output true. CR16 is back-biased, prohibiting current flow; all of the current from the reference current generator flows through forward-biased CR18. In figure 4.14c, current flow is shown with the nor gate output false. Current flows through forward-biased CR16 and no current flows through back-biased CR18.

4.16 INTEGRATOR CIRCUIT.

The integrator circuit converts the currents from the signal and reference generators into the dual slope ramp shown in figure 4.1. During the signal integration period, the integration capacitor (C27) is charged negatively by the negative current from the signal current generator flowing through the signal current gate. The capacitor is then discharged by the positive current from the reference current generator through the reference gate. As

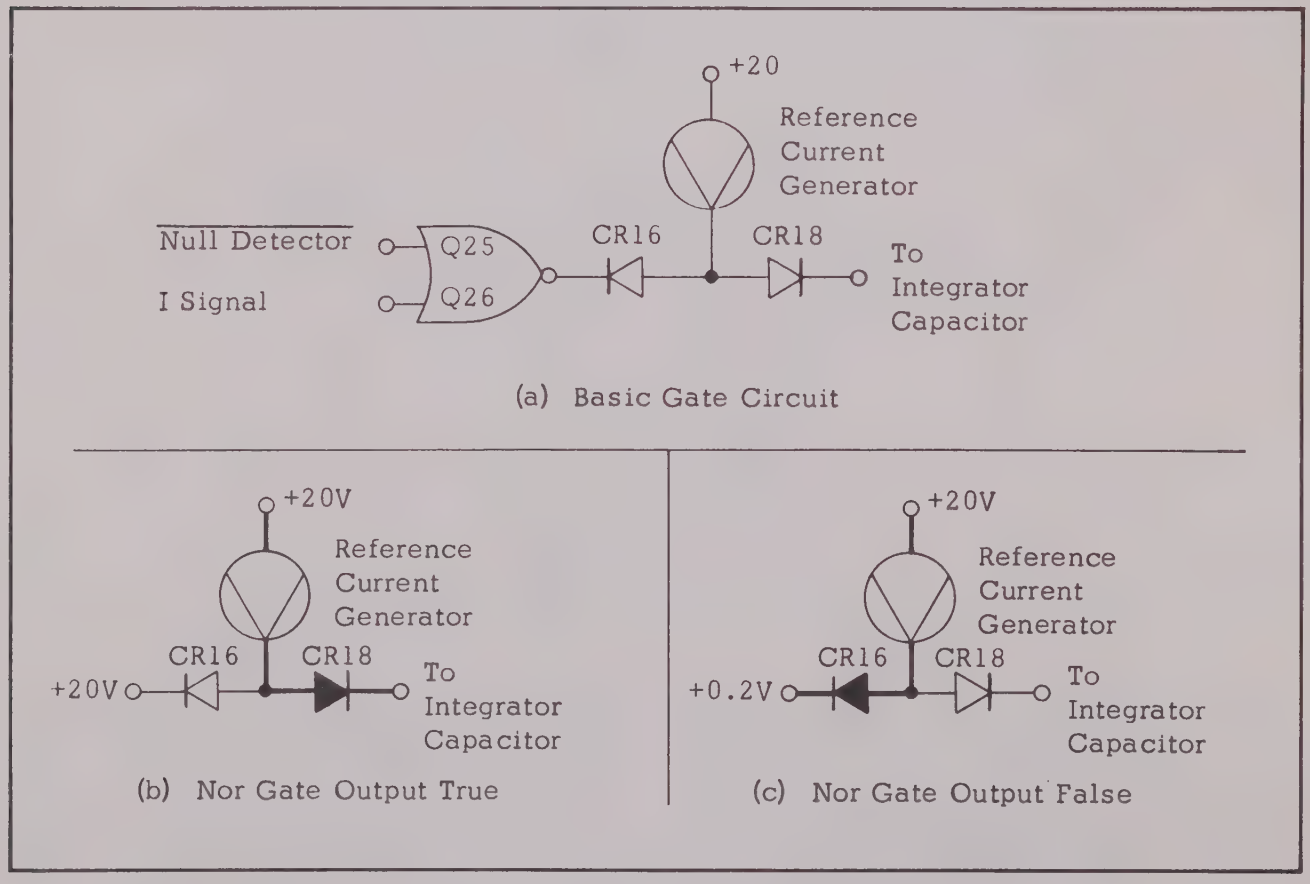


Figure 4.14 - Reference Control Gate Circuit

shown in figure 4.15, the capacitor is referenced to +8.2 volts by zener CR21. The positive level produces required bias for the null detector circuit and simplifies the design requirements for the current gate circuits. Resistor R87 provides a very high resistance shunt (100 Megohms), for C27. During the measurement cycle, the resistor does not affect the operation of the circuitry. When the instrument is placed in external HOLD (on DMM's equipped with Option 1) for long periods of time, the R87 operates in conjunction with the null detector and reference current to hold the capacitor at its operating level.

4.17 NULL DETECTOR.

The null detector monitors the voltage across the integrator capacitor, and converts the integration time period into a digital output. The null detector produces a true (positive) output whenever the voltage across the integrator capacitor is below a positive operating level determined by the null detector, and a false output when the capacitor voltage is equal to or above the operating level.

The null detector circuit is shown simplified in figure 4.16. The input of the null detector is a junction FET (Q29), providing an extremely high input impedance to the integrator circuit. The source of the FET is biased to +8.2 volts by zener CR21 of the integrator circuit, holding the cutoff point of the FET above ground. The FET drives Q30 which inverts and amplifies the FET output. Q30 in turn drives a single stage inverting amplifier Q31.

The operating level of the null detector (the point at which the null detector changes state) is equal to the +8.2 voltage bias at the FET source, less the inherent cutoff point of the junction FET; the cutoff point of the junction FET varies from one device to another. The operating point therefore may lie anywhere between +2V and +6V. The level of the operating point however, does not require compensation, nor does it alter the operation of the instrument.

4.18 POLARITY DETECTOR.

The polarity detector monitors the output of the Isolator and generates a true logic level whenever the isolator output is negative. The polarity detector output drives the polarity indicator circuitry of the digitizing and display portion of the DMM. The detector is a single stage inverting amplifier consisting of Q28.

4.19 DIGITIZING AND DISPLAY.

The digitizing and display section measures the time required for the reference integration period and converts the measured time into a digital display. The D/D section also determines the time required

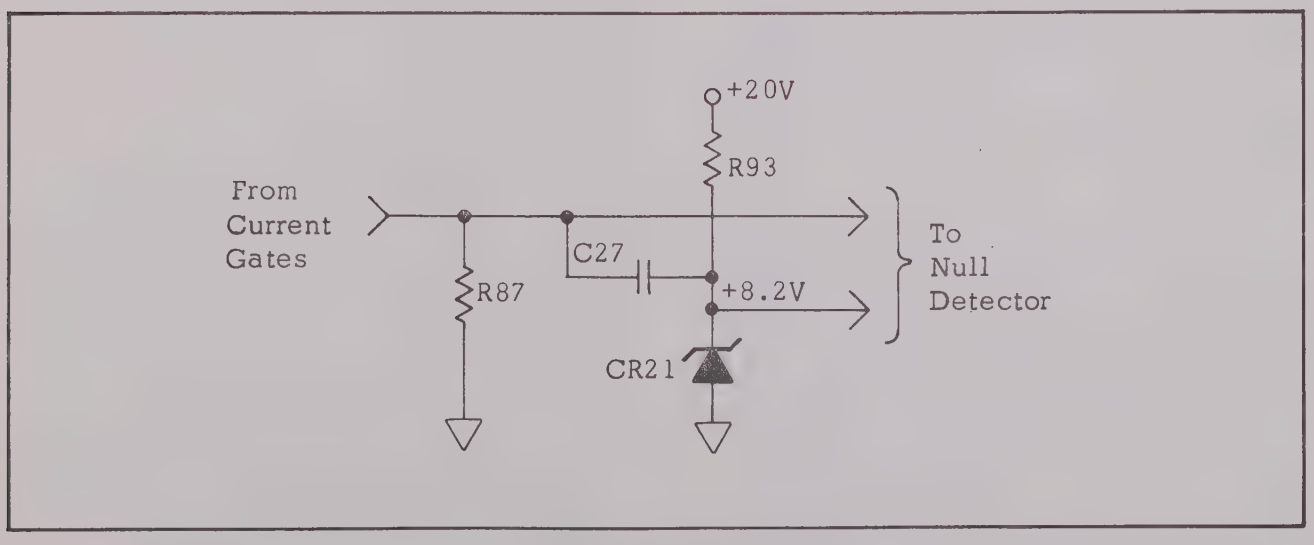


Figure 4.15 - Integrator Circuit

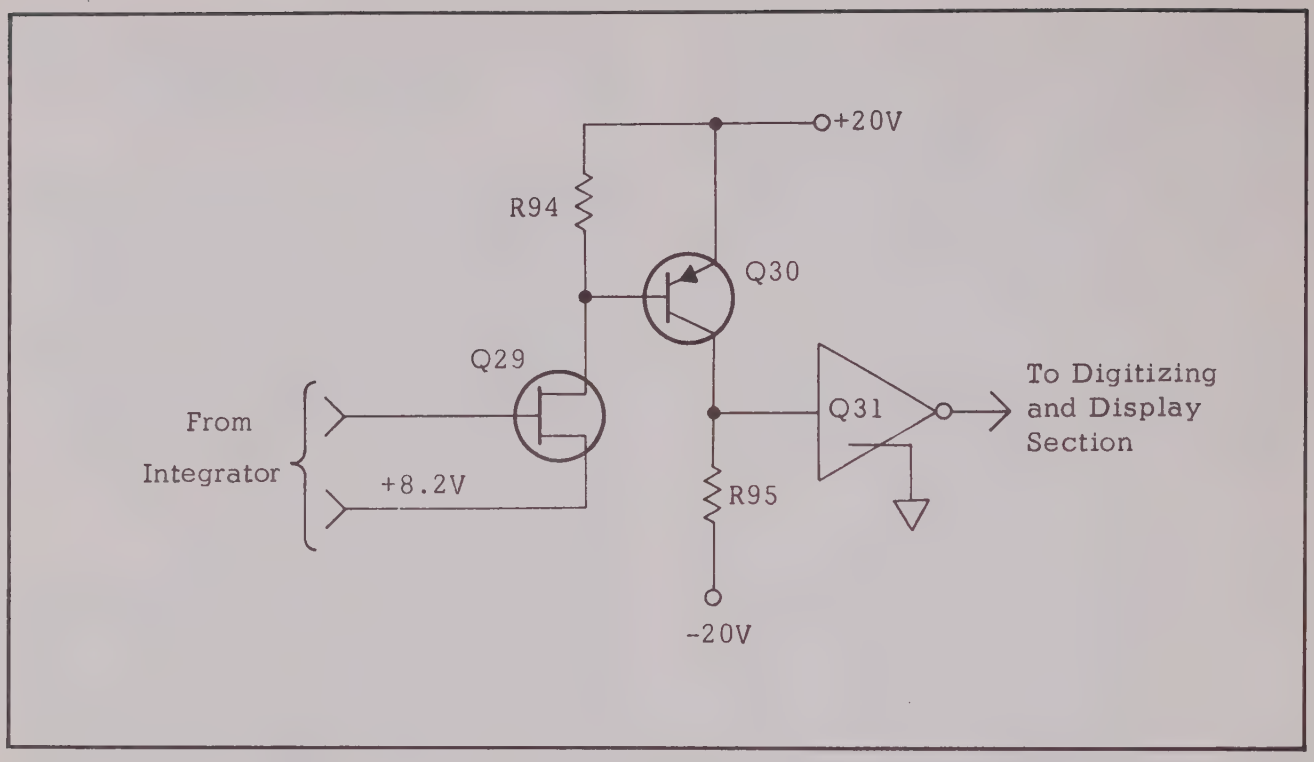


Figure 4.16 - Null Detector

for the signal integration period and establishes the number of readings taken per second.

The DMM readout voltage supply is an unfiltered, half-wave +200 volts. The readout tubes therefore are illuminated 60 times a second and only during each half cycle of the line voltage. The measurement cycle is synchronized with the line frequency and each measurement sequence takes place during a readout blank period (less than 8.3 ms). The instrument takes between four and five measurements each second.

The D and D section (shown simplified in figure 4.17) consists of a binary counter, driven by a clock-oscillator. The counter advances at the clock rate (approximately 400 kHz) from 0000 to 1999 and then overflows to 0000. The clock runs during the entire integration cycle (T0-T2) and at the start of a measurement, the counter is set to 1000. During the signal integration period (T0-T1) the counter advances from 1000 until overflow at which time the signal integration period is terminated. The time required for the counter to advance from 1000 to 0000 (1000 clock cycles) determines the signal integration period. The counter continues from 0000 at the clock rate until the completion of the reference integration period (T1-T2). At this time the clock is stopped. The position of the counter is converted from binary data to 10-line data and displayed by the readout tubes.

4.20 SHAPER.

A 60 Hz (line frequence) signal is monitored at the 25V winding of the power supply transformer and converted to a +4V -0 volts square wave by the shaper circuit as shown in figure 4.18. The circuit consists of a current limiting resistor R98, diode CR22, and inverter M19. During the time the 60 Hz input is negative, the current through R98 is shunted to ground and the inverter output is +4 volts. When the input is positive, the inverter is on with an output of zero volts. The shaper output is used to synchronize the rate generator, and on instruments equipped with Option 1, used in conjunction with the DMM command circuitry.

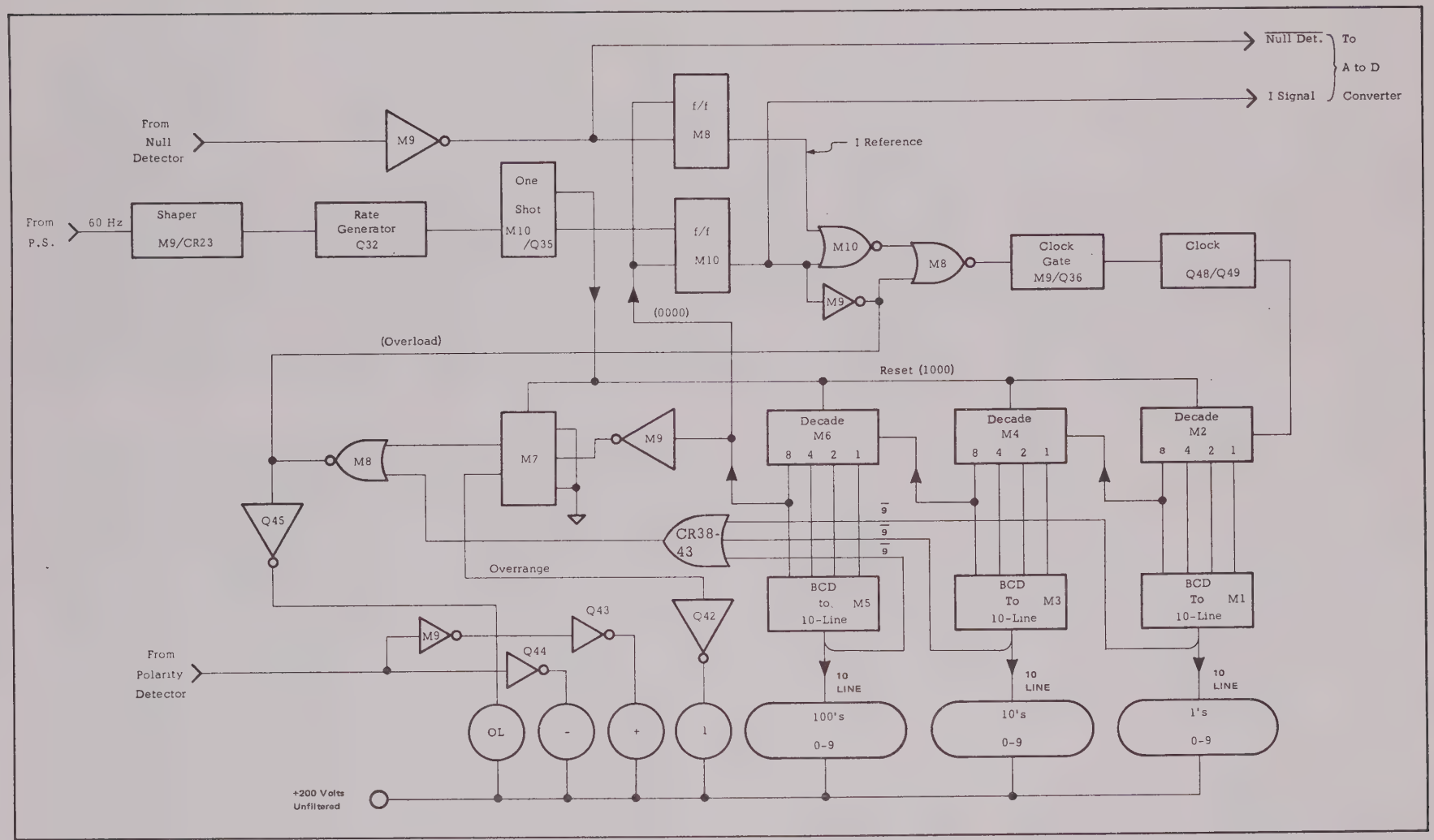


Figure 4.17 - D/D Section

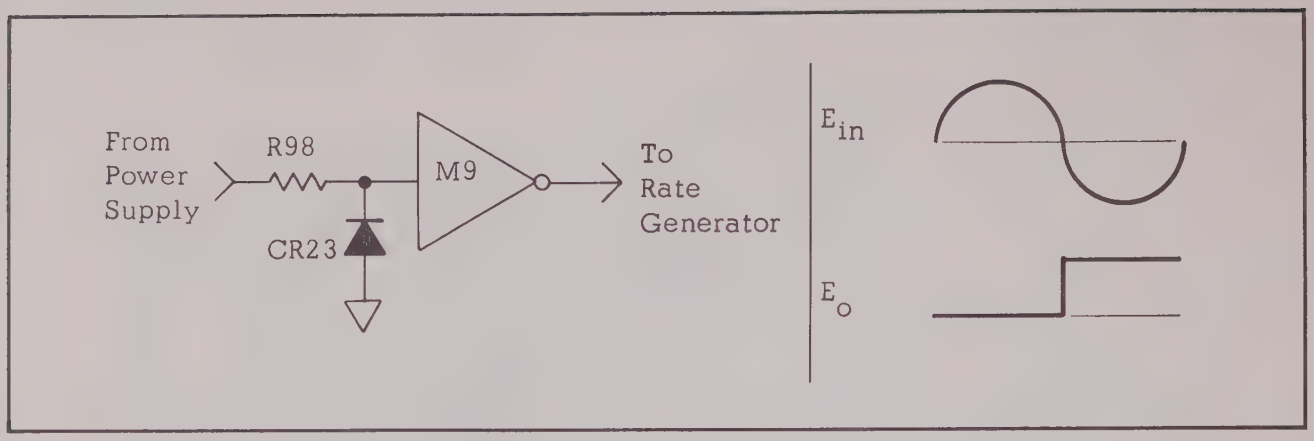


Figure 4.18 - Shaper Circuit

4.21 RATE GENERATOR.

The rate generator is a unijunction oscillator, consisting of Q37, and is synchronized to the line frequency by the shaper output through C29. The rate generator produces a pulse approximately five times a second and drives the reset oneshot.

4.22 RESET ONESHOT.

The reset oneshot (shown in figure 4.19) is driven by the rate generator and consists of NOR gate M10 and transistor Q35. The oneshot produces two outputs; the Reset is a positive 18 microsecond pulse and resets the counter to 1000 for the start of a measurement cycle; the $\overline{\text{Reset}}$ is the reciprocal of the $\overline{\text{reset}}$ pulse (output is normally +4 volts going to zero for 18 microseconds during the $\overline{\text{reset}}$ pulse) and drives the I Signal flip-flop (f/f).

4.23 I SIGNAL F/F.

The I Signal f/f output is set true by $\overline{\text{Reset}}$ and reset (false) by the counter overflow. The I Signal enables the signal current gate on the A to D converter section and provides one of the inputs for the clock enable circuit on the D/D section. The I Signal f/f consists of two NOR gates M10-M10 and is shown in figure 4.20.

4.24 I REFERENCE F/F.

The I Reference flip-flop (shown in figure 4.21) consists of two NOR gates M8-M8. The I Reference output is set true by the counter overflow and reset false by null detector from inverter M9. The I Reference flip-flop is true during the reference integration period (T1-T2) and provides the second input to the clock enable circuit.

4.25 CLOCK ENABLE.

The clock enable circuitry shown in figure 4.22 turns the clock oscillator on and off and consists of NOR gate M10-M8, inverter M9 and transistor Q46. I Signal input is true during the signal integration period and I Reference input is true during the reference integration period. These two inputs hold the output of M10 false during the measurement period (T0-T2). The output of M10 and the output of the overload circuit are fed to NOR gate M8. For normal measurements overload is false. During the measurement cycle therefore, the two inputs to M8 are false, making the M8 output true for this same period. The M8 output is inverted and applied, through resistor R136 to the base of Q46. Q46 therefore is off during the measurement cycle and on during the display cycle.

4.26 CLOCK.

The clock is a free running multi-vibrator circuit consisting of transistors Q48 and Q49. The biasing for the base of Q48 is provided by resistors R139 and R140 connected in series. The junction of the two resistors is connected to the collector of Q46. During the display cycle, Q46 is on, holding Q48 off and the clock does not operate. At the start of

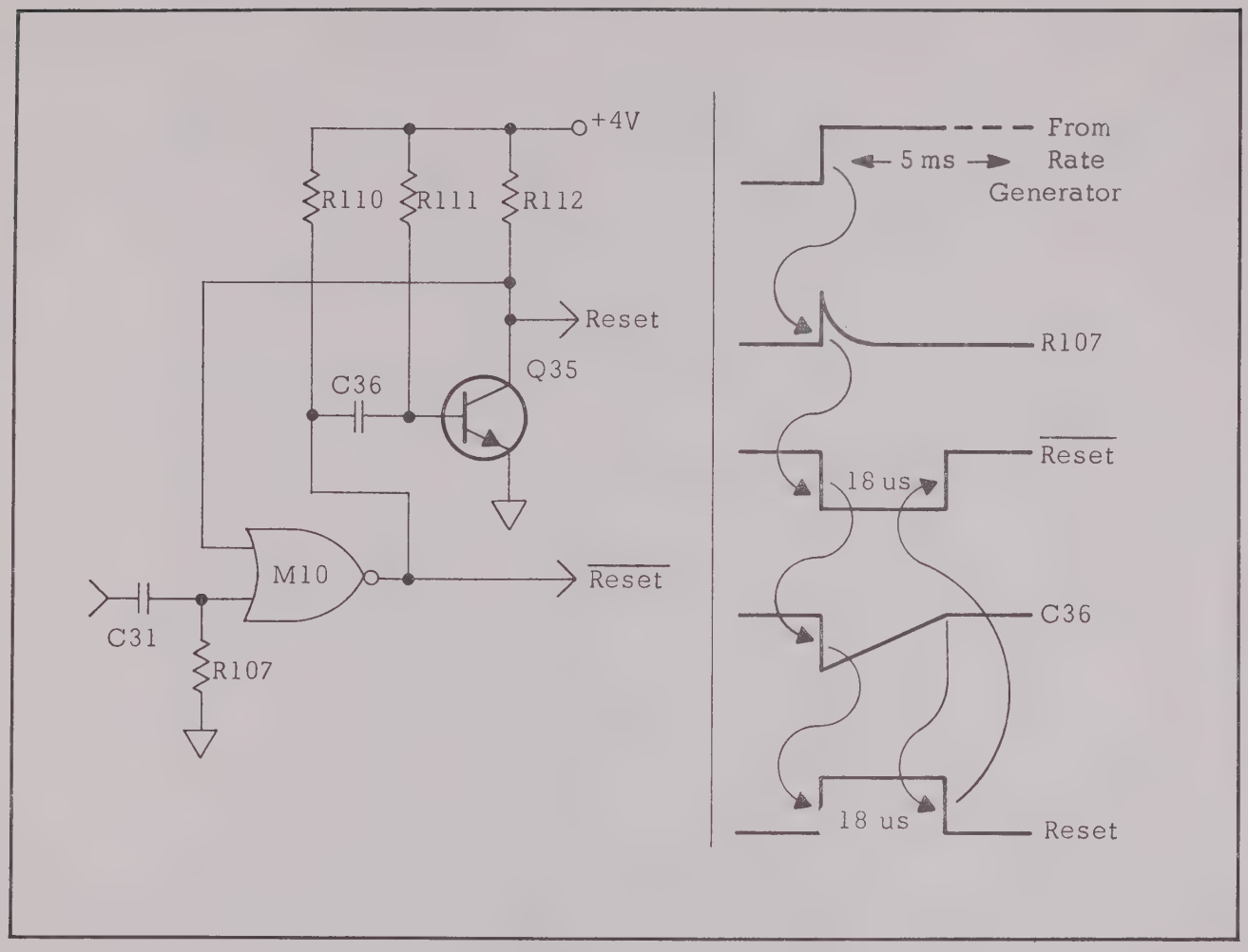


Figure 4.19 - Reset One Shot

the measurement cycle, Q46 is turned off allowing Q48 to begin conducting. This allows the clock to be started in the same direction at the beginning of each measurement cycle. The clock output is fed directly to the counter.

4.27 COUNTER.

The counter is a standard 3 decade counter consisting of M2, M4, and M6 and flip-flop M7. The output of the 8 bit of M6 is inverted by inverter M9 and drives M7 which provides the overrange bit. The decades generate an inverted logic 1-2-4-8 output which in turn drives three, BCD to 10-line converters. The counter counts the number of cycles generated by the clock. The three decades are reset to zero by the reset pulse; the overrange f/f is reset true (1) by the reset pulse.

4.28 BCD TO 10-LINE CONVERTERS.

The BCD converters consisting of M1, M3, and M5 convert the BCD data from the decade counters and drive the readout tubes.

4.29 OVERLOAD.

The overload circuit consisting of NOR gate M8 monitors the output of the overrange f/f and the #9 lines of M1, M3, and M5. When all of these lines are false, indicating a count of 1999, the output of M8 goes true enabling overload driver Q45 to

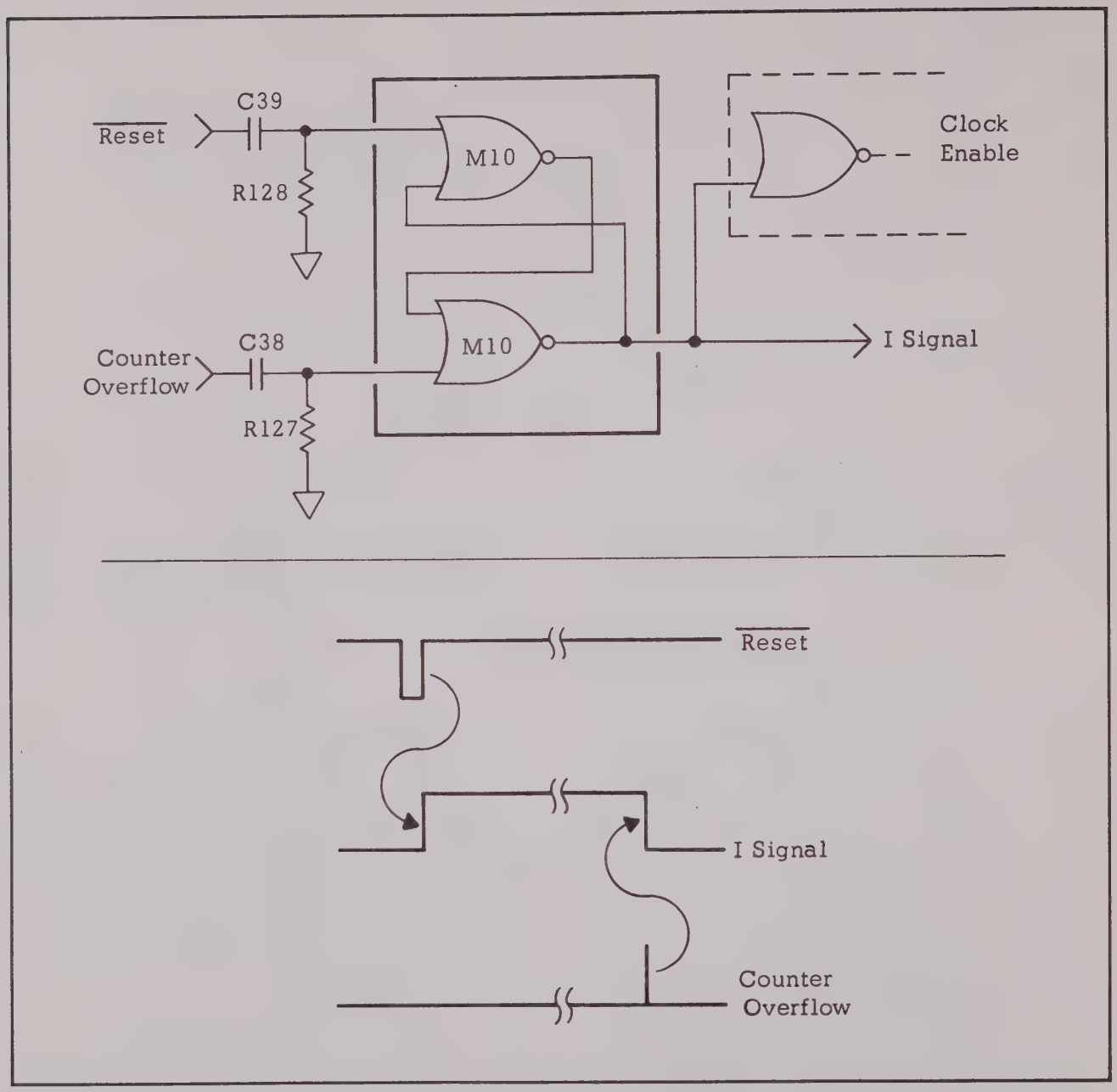


Figure 4.20 - I Signal f/f

conduct and inhibiting the counter. The overload output (as shown in figure 4.23) is also connected to the output of inverter M9. M9 conducts during the I Signal period and prevents the overload from going true during the 1000 to overflow period.

4.30 POLARITY DISPLAY.

The polarity display consists of inverter M9 and drivers Q43 and Q44. The inverter and Q44 are driven by the polarity detector circuit of the A to

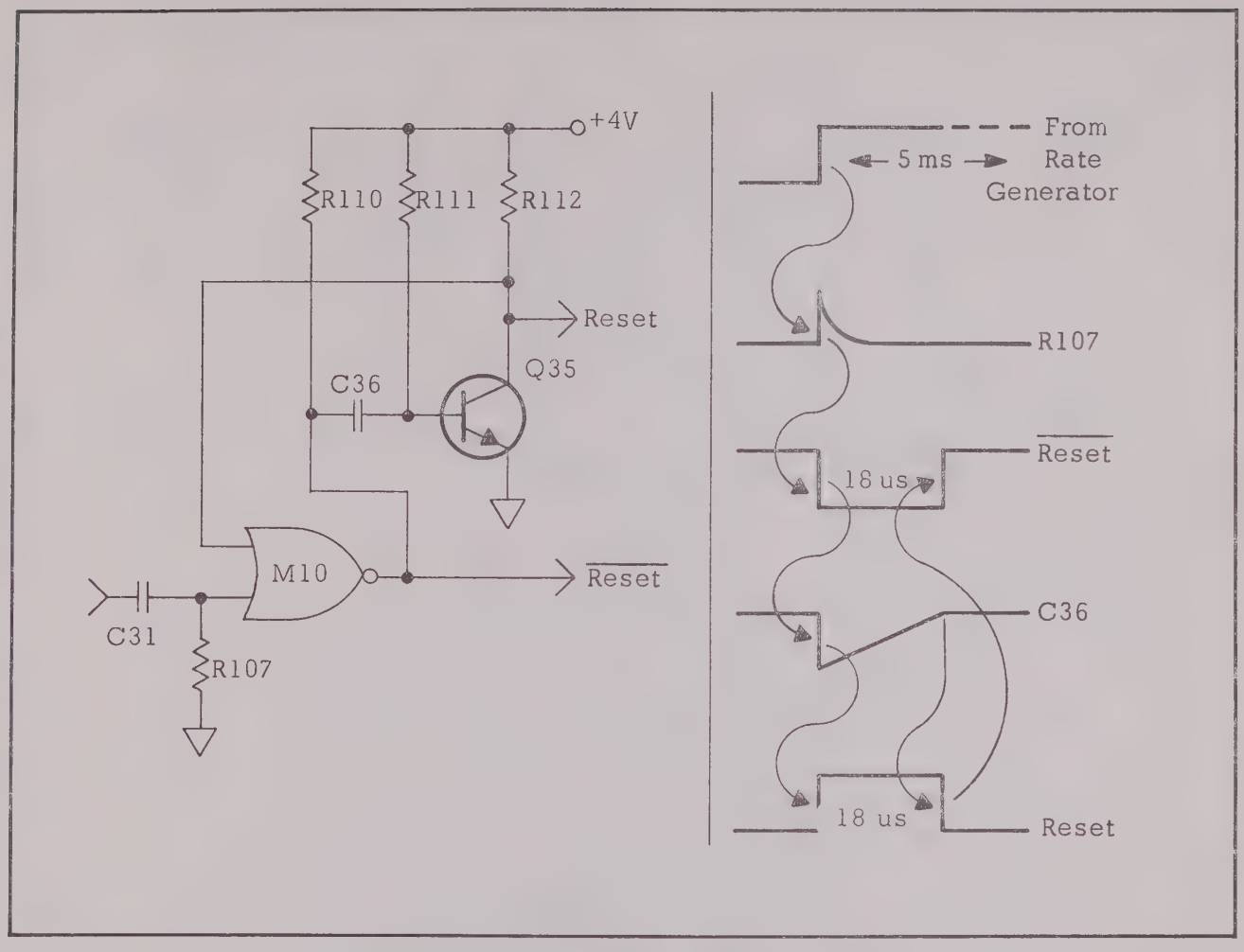


Figure 4.19 - Reset One Shot

the measurement cycle, Q46 is turned off allowing Q48 to begin conducting. This allows the clock to be started in the same direction at the beginning of each measurement cycle. The clock output is fed directly to the counter.

4.27 COUNTER.

The counter is a standard 3 decade counter consisting of M2, M4, and M6 and flip-flop M7. The output of the 8 bit of M6 is inverted by inverter M9 and drives M7 which provides the overrange bit. The decades generate an inverted logic 1-2-4-8 output which in turn drives three, BCD to 10-line converters. The counter counts the number of cycles generated by the clock. The three decades are reset to zero by the reset pulse; the overrange f/f is reset true (1) by the reset pulse.

4.28 BCD TO 10-LINE CONVERTERS.

The BCD converters consisting of M1, M3, and M5 convert the BCD data from the decade counters and drive the readout tubes.

4.29 OVERLOAD.

The overload circuit consisting of NOR gate M8 monitors the output of the overrange f/f and the #9 lines of M1, M3, and M5. When all of these lines are false, indicating a count of 1999, the output of M8 goes true enabling overload driver Q45 to

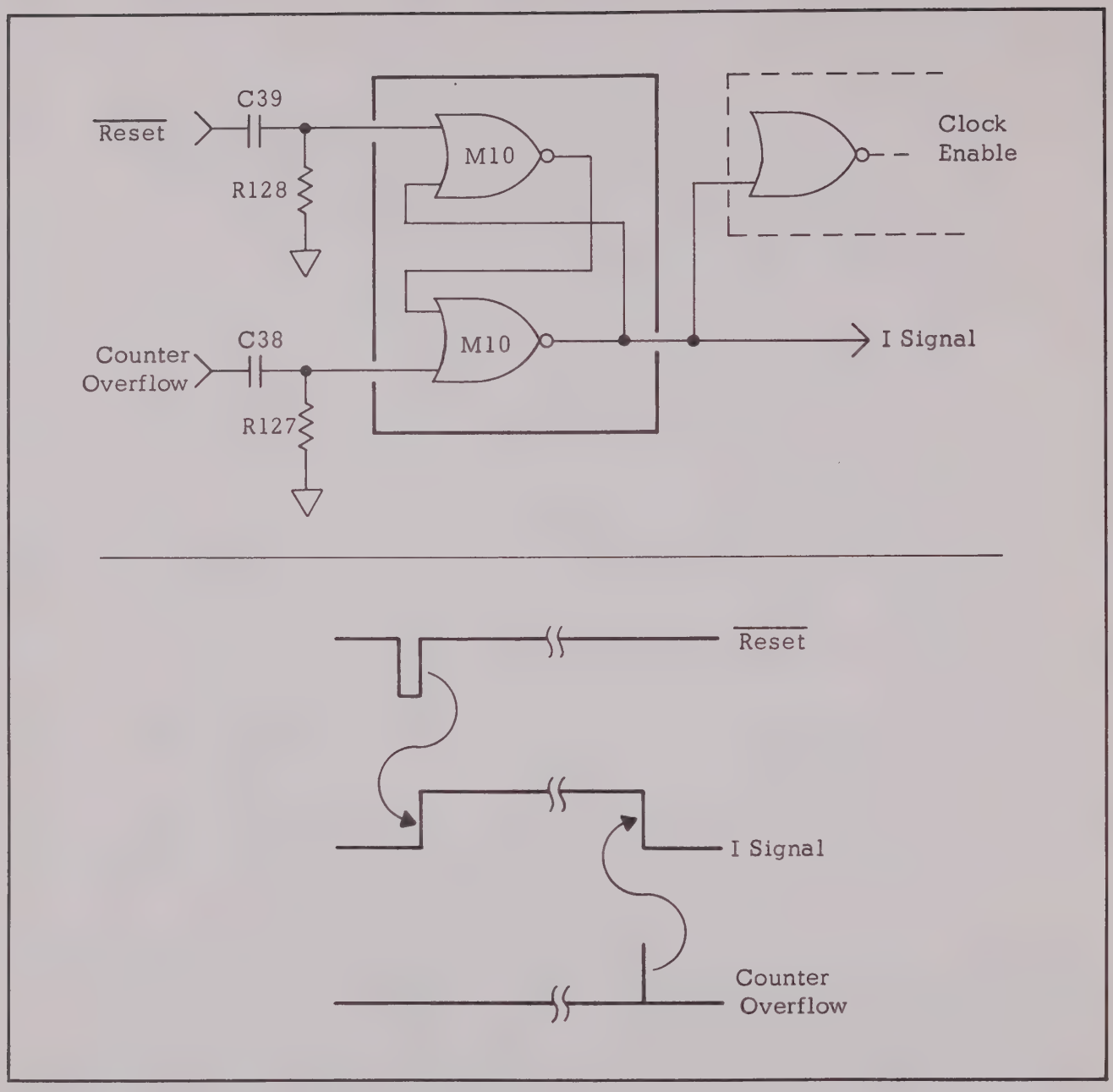


Figure 4.20 - I Signal f/f

conduct and inhibiting the counter. The overload output (as shown in figure 4.23) is also connected to the output of inverter M9. M9 conducts during the I Signal period and prevents the overload from going true during the 1000 to overflow period.

4.30 POLARITY DISPLAY.

The polarity display consists of inverter M9 and drivers Q43 and Q44. The inverter and Q44 are driven by the polarity detector circuit of the A to

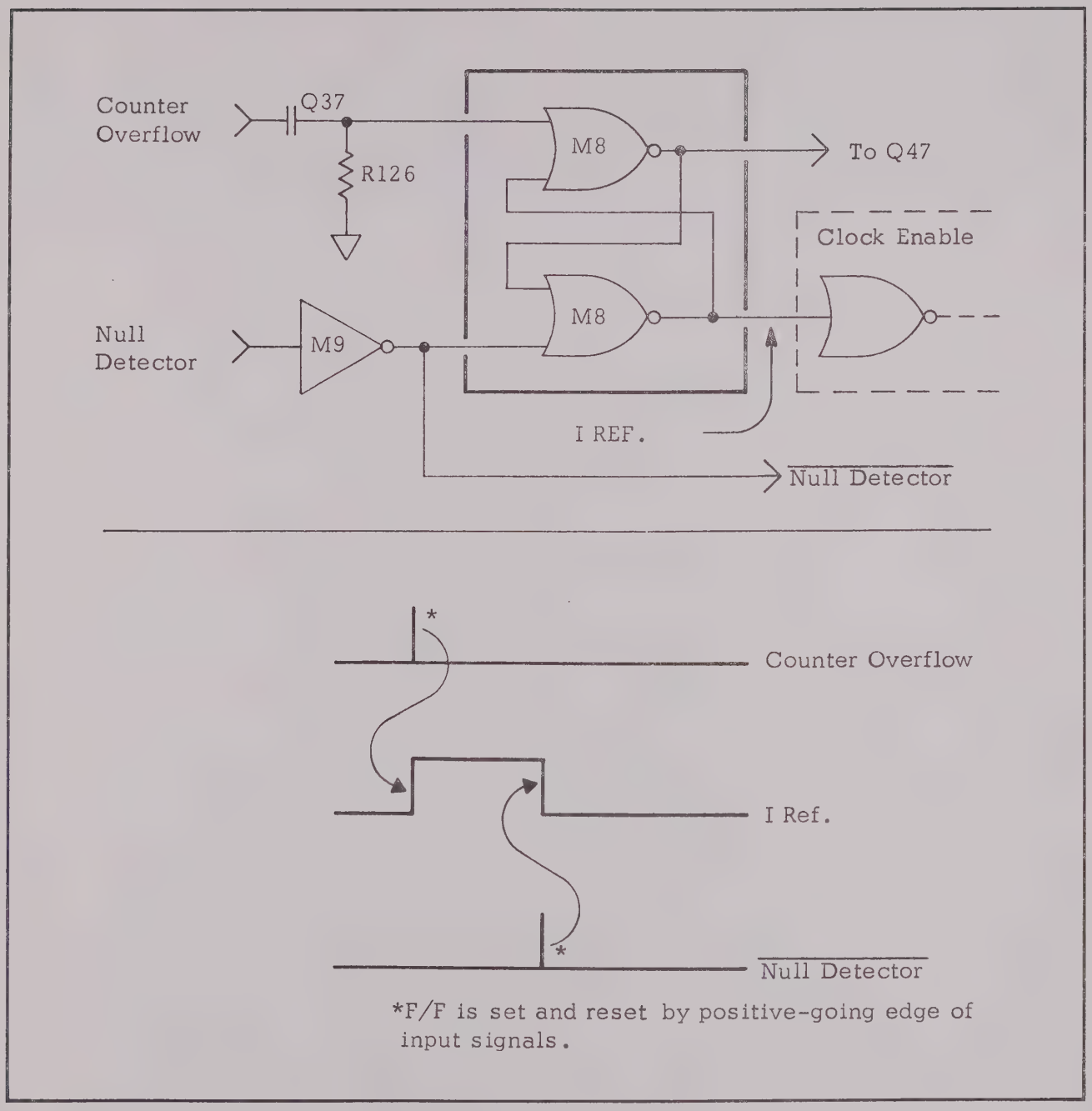


Figure 4.21 - I Reference f/f

D converter section. Q43 is driven by the output of the inverter. Both polarity drivers are inhibited by diodes CR33 and CR34 when the NO polarity line is false. (No polarity is false on the AC and Ohms functions.)

4.31 COUNTER MEMORY.

The circuit consists of Q47 and prevents the I Reference f/f from firing during the reset pulse and immediately following the measurement cycle.

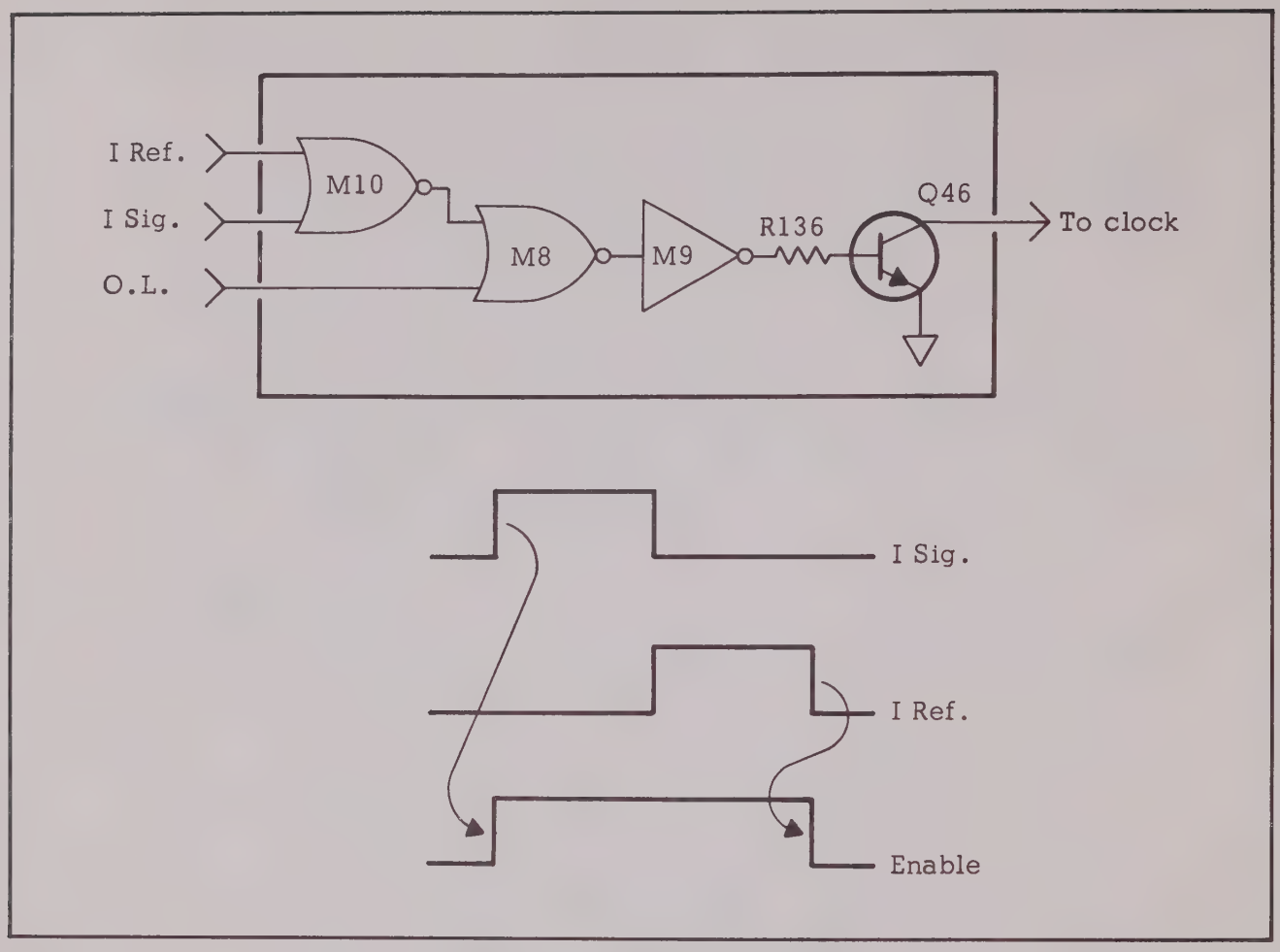


Figure 4.22 - Clock Enable Circuit

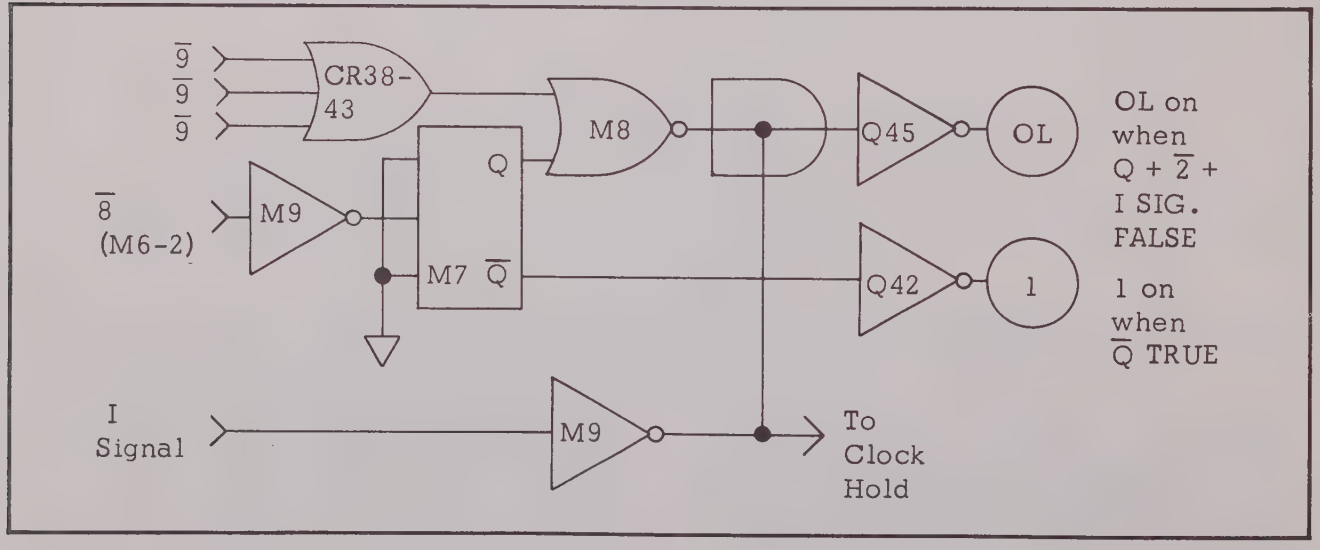


Figure 4.23 - Overload/Overrange Circuit

4.32 POWER SUPPLY.

The power supply figure 4.24 provides the operating voltage levels for the entire DMM. The +200 supply supplies an unfiltered half-wave voltage to the display tubes. The +4 volt output supplies the operating voltage for all of the integrated circuitry and consists of transistors Q33 and Q34. A full wave rectified and filtered +7 volts is regulated by a resistor divided reference from the +20 volt supply. The +20 volt supply is series regulated by transistors Q36, Q37, and zener CR31. The supply is current protected by Q38. The −20 volt supply is series regulated by Q39, Q40, and zener CR32. The −20 volt supply is current protected by transistor Q41.

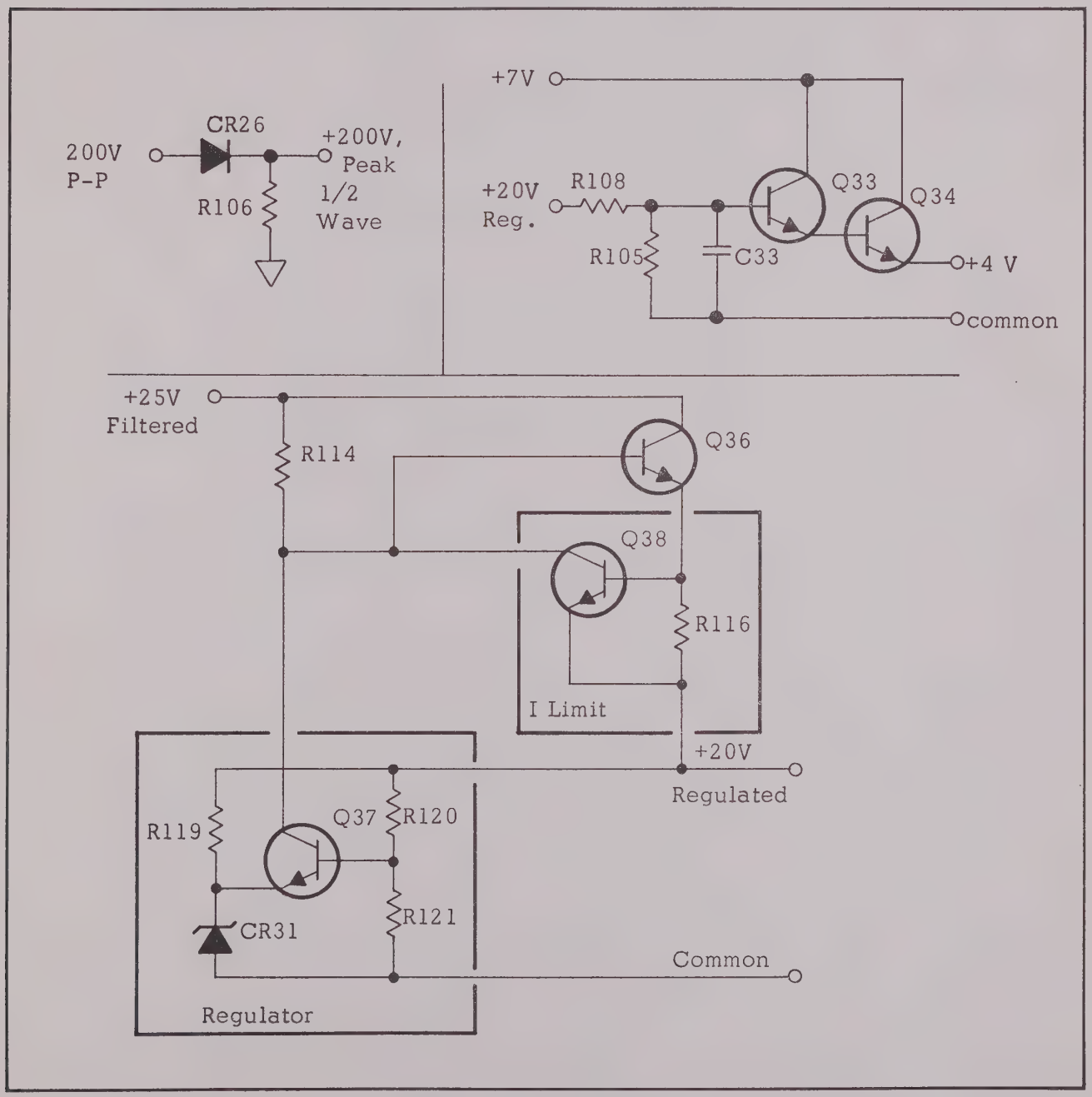


Figure 4.24 - Power Supply

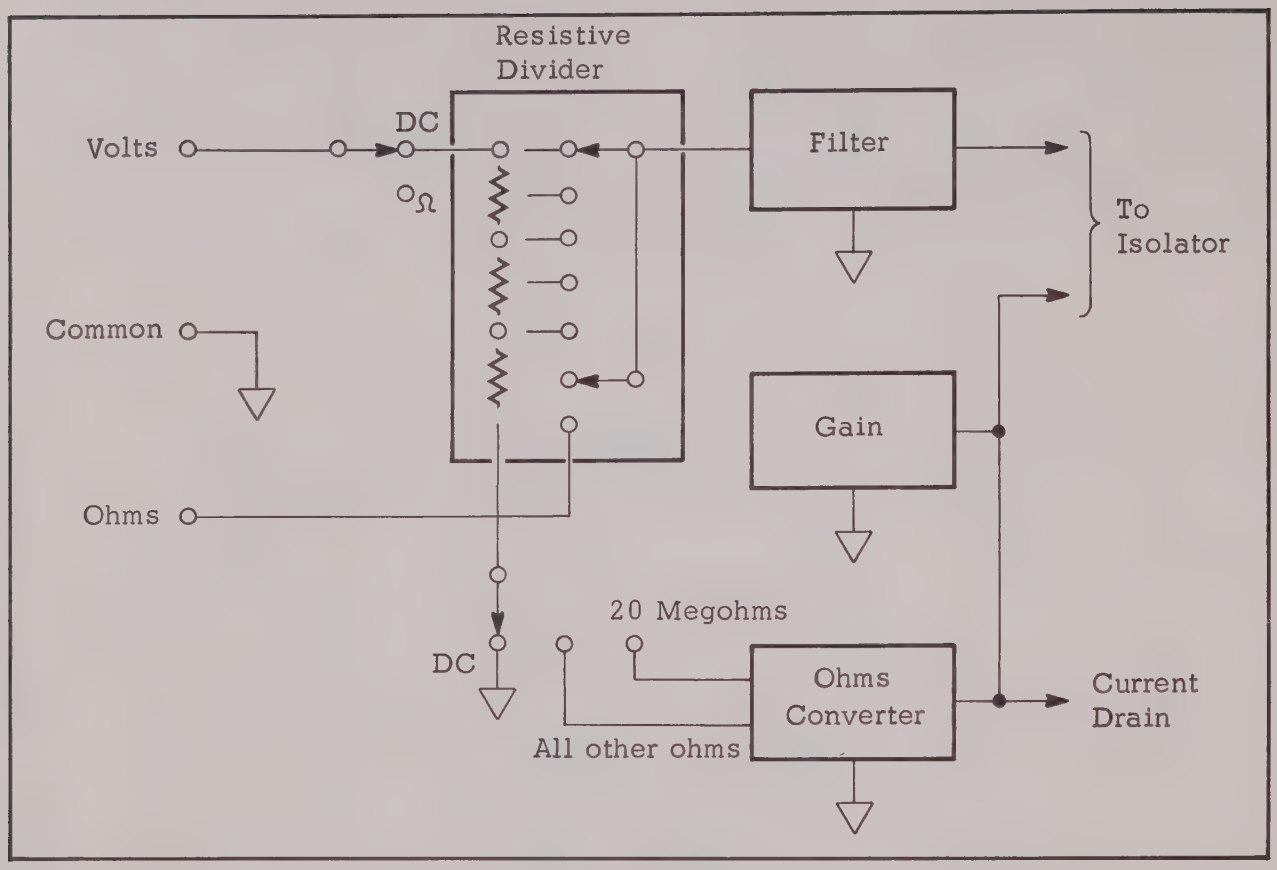


Figure 4.25 - Model 3860A - Signal Conditioning Portion

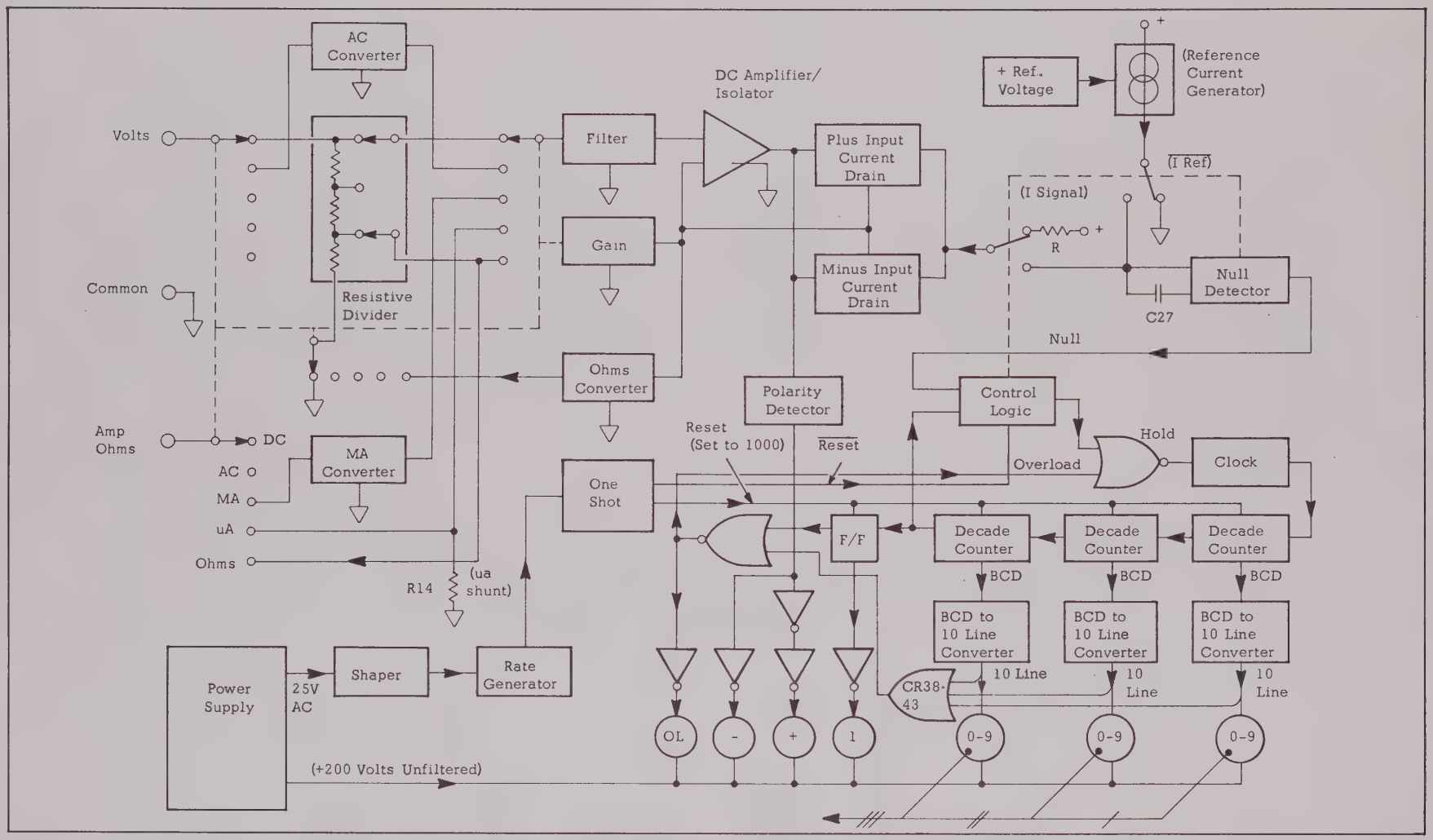


Figure 4.26 - Series 3800A DMM - Block Diagram

SECTION 5

CALIBRATION

5.1 INTRODUCTION.

This calibration procedure is designed to assure the Series 3800A DMM operates within its specifications. Any necessary maintenance should be done prior to calibration. The calibration steps in this procedure rely on the adjusted accuracy of the preceding step, therefore care must be taken to make each adjustment in the order that it appears in this procedure.

5.2 EQUIPMENT REQUIRED.

The following equipment, or an acceptable equivalent, is required for DMM calibration and is listed in order of use. The test equipment specifications listed are used and recommended by DANA for calibration.

1. BASIC DC CALIBRATION OF THE DMM

   a. A precision DC voltage standard variable from 0 to 1000 volts having a resolution of 100 microvolts at 10 volts and an accuracy of .003%. For example, the COHU MODEL 351.

   b. A precision decade divider having an input resistance of 10 Kohms and an output resistance of 5 Kohms maximum, and an accuracy of .005%. For example, the ESI MODEL RV622A.

2. AC CALIBRATION OF THE DMM*

   a. An AC laboratory power source, variable from 0 to 500 volts RMS and 50 Hz to 100 kHz, having a resolution better than 100 PPM, harmonic distortion of .1%. For example, the OPTIMATION type AC 104 (oscillator, matching transformer, and power amplifier).

   b. An AC/DC laboratory transfer standard (for calibration of the AC source) having an accuracy of .05%. For example, the HOLT MODEL 6 thermal transfer voltmeter.

3. MILLIAMPS AND MICROAMPS CALIBRATION OF THE DMM*

   a. A power supply with the capability of delivering 1000 mA in the current mode. For example, the SORRENSON QRB 30-1.

   b. A current shunt resistor capable of 1 amp to standardize the current source. For example, 10 volts across 10 ohms.

4. OHMS CALIBRATION OF THE DMM

   a. Standard resistors: 100 ohms, 1 Kohm, 100 Kohm, and 1 Mohm with a value known to .005% and a 10 Mohm with a value known to .01%. For example the ESI SR-1 series standard resistors.

5. TOOLS REQUIRED FOR CALIBRATION

   a. An insulated blade type calibration tool.

   b. A No. 1 Phillips screwdriver.

*Required for calibrating the Model 3800A only.

6. PREPARATION FOR CALIBRATION

a. Remove the five screws on the back panel of the DMM and slide the panel out of the strain relief bushing on the AC power cord. Slide the DMM circuit board through the front of the case to expose the adjustments.

b. Set the DMM controls as follows:

Function:	Volts DC
Range:	10
Input:	Shorted (Red to black)

c. Set the ON-OFF switch to the ON position and allow 30 minutes for warmup.

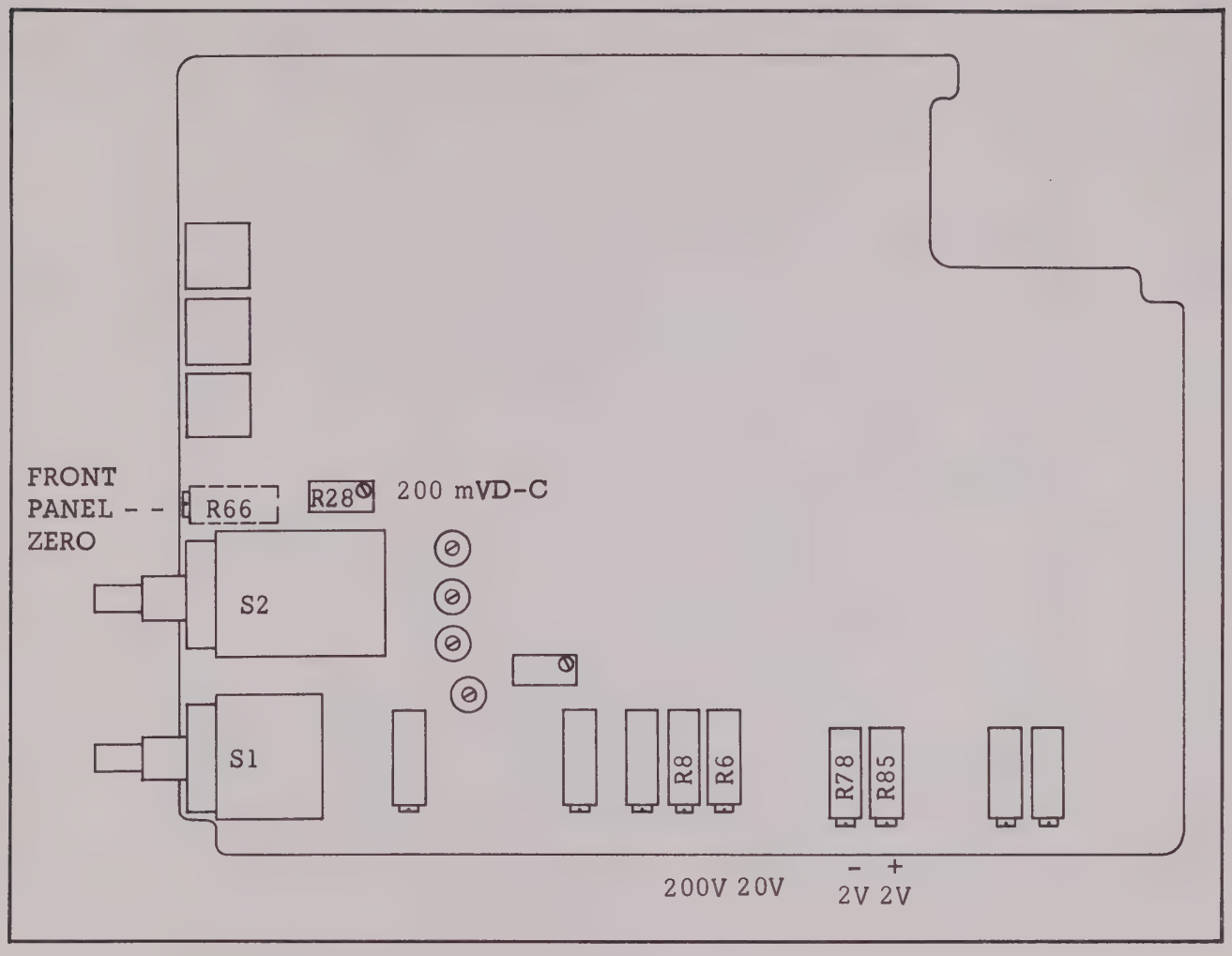


Table 5.1 - DC Calibration

FUNCTION	RANGE	INPUT	ADJUST	DISPLAY	REMARKS
VDC	200 mVDC	0V	R66	00.0	Polarity Indicators flashing
VDC	2 VDC	+1.190	R85	+1.190	Plus full scale adjust
VDC	2 VDC	-1.190	R78	-1.190	Minus full scale adjust
VDC	200 mVDC	+119.0mV	R28	+119.0mV	Millivolts full scale adjust
VDC	200 mVDC	-119.0mV	—	-119.0mV	± 1 digit
VDC	20 VDC	+11.90V	R6	+11.90V	10 volt full scale adjust
VDC	20 VDC	-11.90V		-11.90V	10 volt full scale adjust
VDC	200 VDC	+119.0V	R8	+119.0V	100 volt full scale adjust
VDC	200 VDC	-119.0V		-119.0V	100 volt full scale adjust

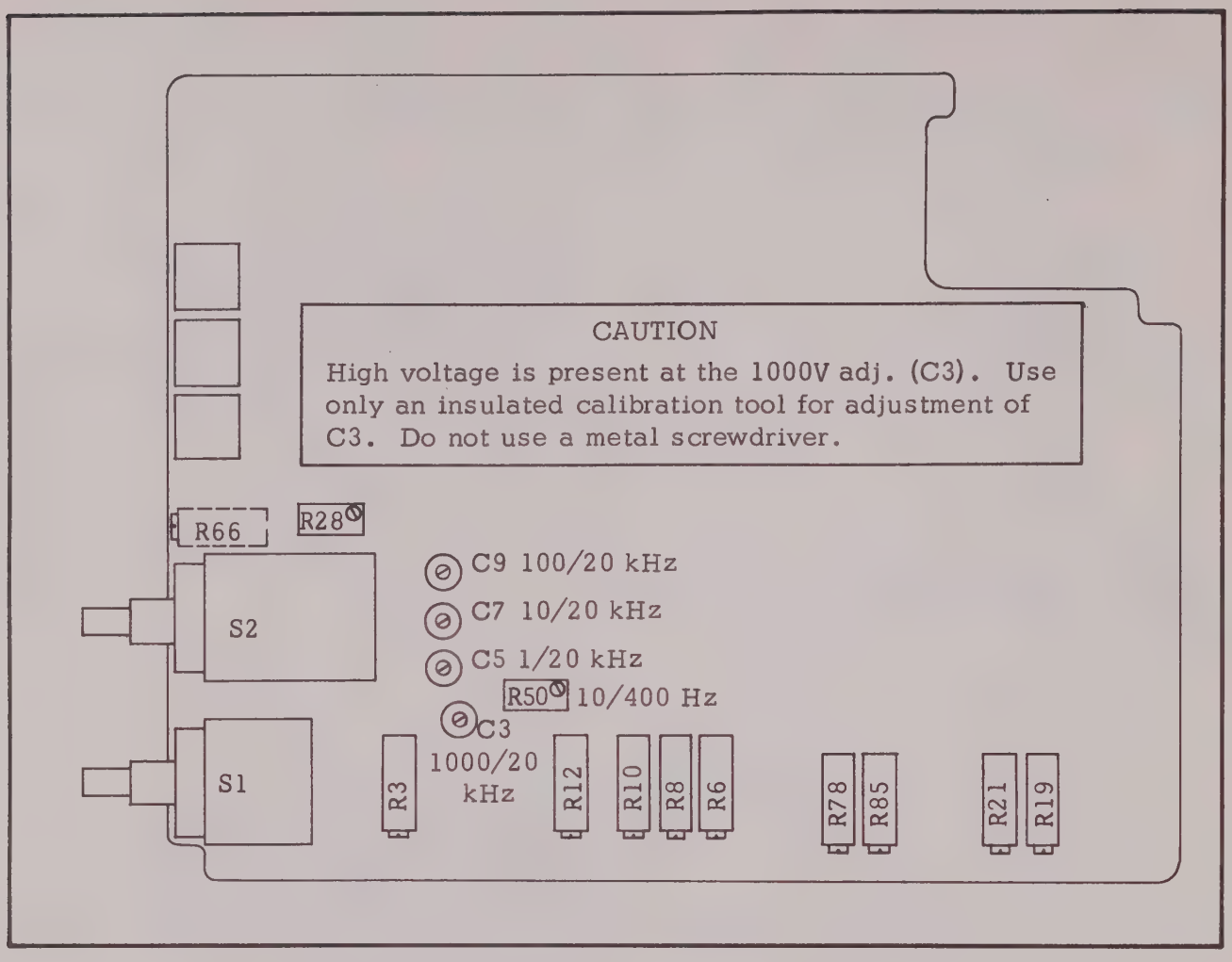


Table 5.2 - AC Calibration

FUNCTION	RANGE	INPUT	ADJUST	DISPLAY	REMARKS
VAC	10 VAC	11.90VRMS	R50	11.90VRMS	@ 400 Hz
VAC	1000 VAC	500.0VRMS	C3	500.0VRMS	± 5 digits @ 20 kHz
VAC	1 VAC	1.190VRMS	C5	1.190VRMS	± 5 digits @ 20 kHz
VAC	10 VAC	11.90VRMS	C7	11.90VRMS	± 5 digits @ 20 kHz
VAC	100 VAC	119.0VRMS	C9	119.0VRMS	± 5 digits @ 20 kHz

CAUTION

When changing frequency of the AC Generator, decrease the output voltage. This will prevent switching transients (up to 1000 v.) from damaging the DVM input circuitry.

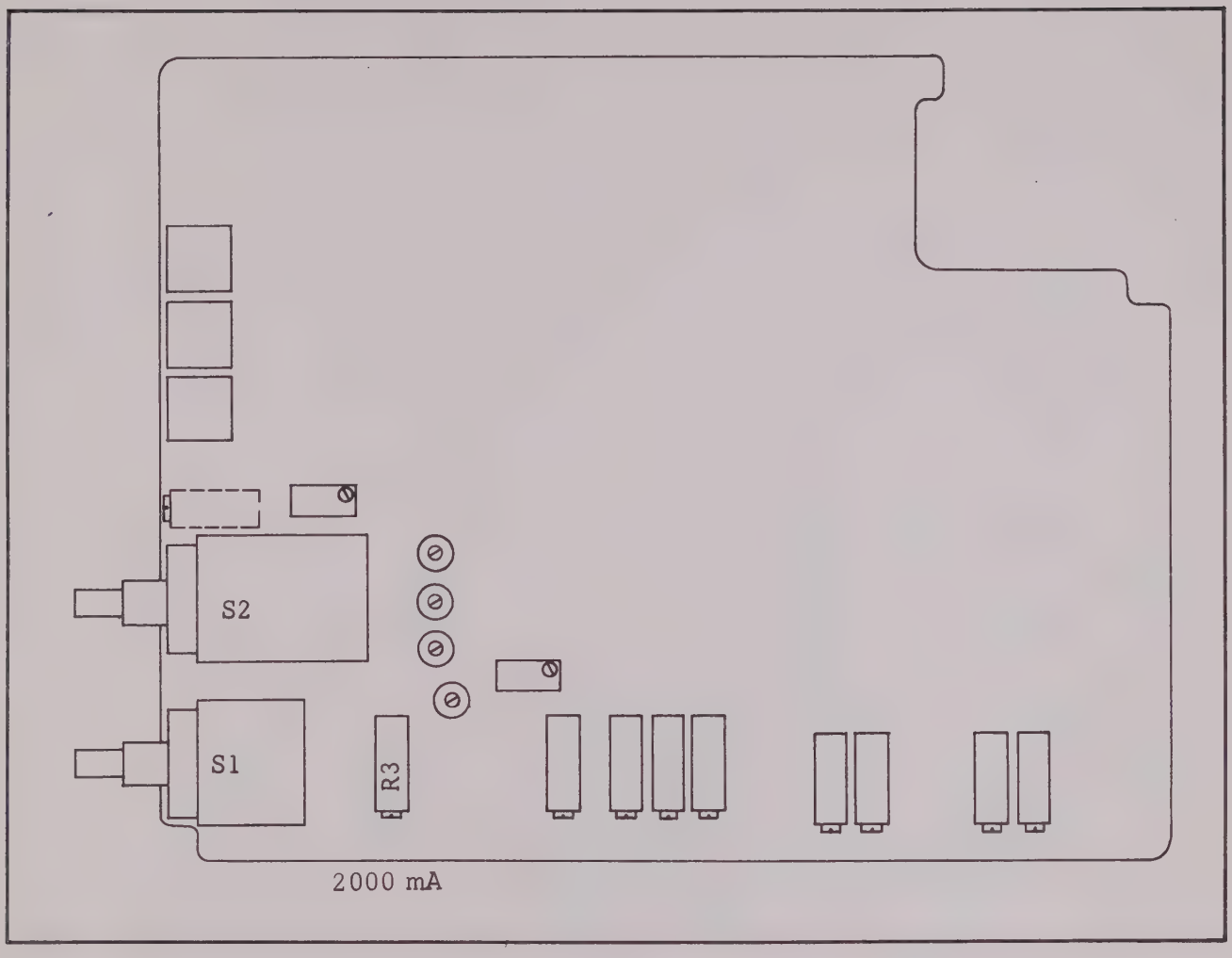


Table 5.3 - Current Calibration (3800A only)

FUNCTION	RANGE	INPUT	ADJUST	DISPLAY	REMARKS
MADC	2000 mADC	+1190 mA	R3	+1190 mADC	Milliamp full scale adjust
MADC	2000 mADC	-1190 mA	—	-1190 mADC	± 2 digits
MADC	200 mADC	+100.0 mA	—	+100.0 mADC	± 2 digits
MADC	200 mADC	-100.0 mA	—	-100.0 mADC	± 2 digits
MADC	20 mADC	+10.00 mA	—	+10.00 mADC	± 2 digits
MADC	20 mADC	-10.00 mA	—	-10.00 mADC	± 2 digits
MADC	2 mADC	+1.000 mA	—	+1.000 mADC	± 2 digits
MADC	2 mADC	-1.000 mA	—	-1.000 mADC	± 2 digits
uADC	200 uADC	+100.0 uA	—	+100.0 uADC	± 2 digits
uADC	200 uADC	-100.0 uA	—	-100.0 uADC	± 2 digits
uADC	20 uADC	+10.00 uA	—	+10.00 uADC	± 2 digits
uADC	20 uADC	-10.00 uA	—	-10.00 uADC	± 2 digits

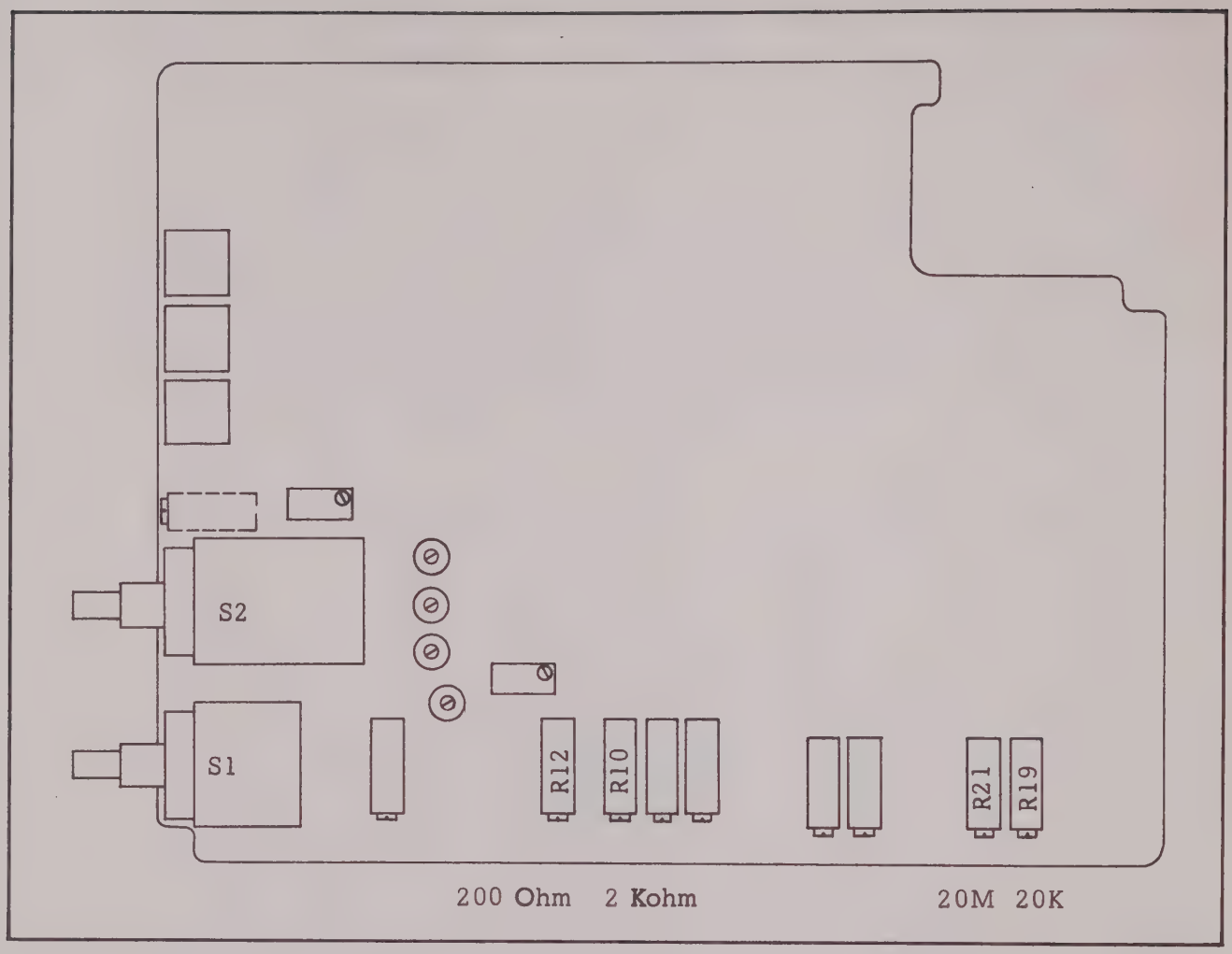


Table 5.4 - Resistance Calibration

FUNCTION	RANGE	INPUT	ADJUST	DISPLAY	REMARKS
Ohms	20 Kohm	10 Kohm	R19	10.00	± 1 Digit
Ohms	20 Mohm	10 Mohm	R21	10.00	± 1 Digit
Ohms	2 Kohm	1 Kohm	R10	1.000	± 1 Digit
Ohms	200 Ohm	100 Ohm	R12	100.0*	± 1 Digit *(Short input leads, note digits offset, and adjust the display for the standard plus the offset)
Ohms	2000 Kohm	1 Mohm	—	1000	± 1 Digit
Ohms	200 Kohm	100 Kohm	—	100.0	± 1 Digit

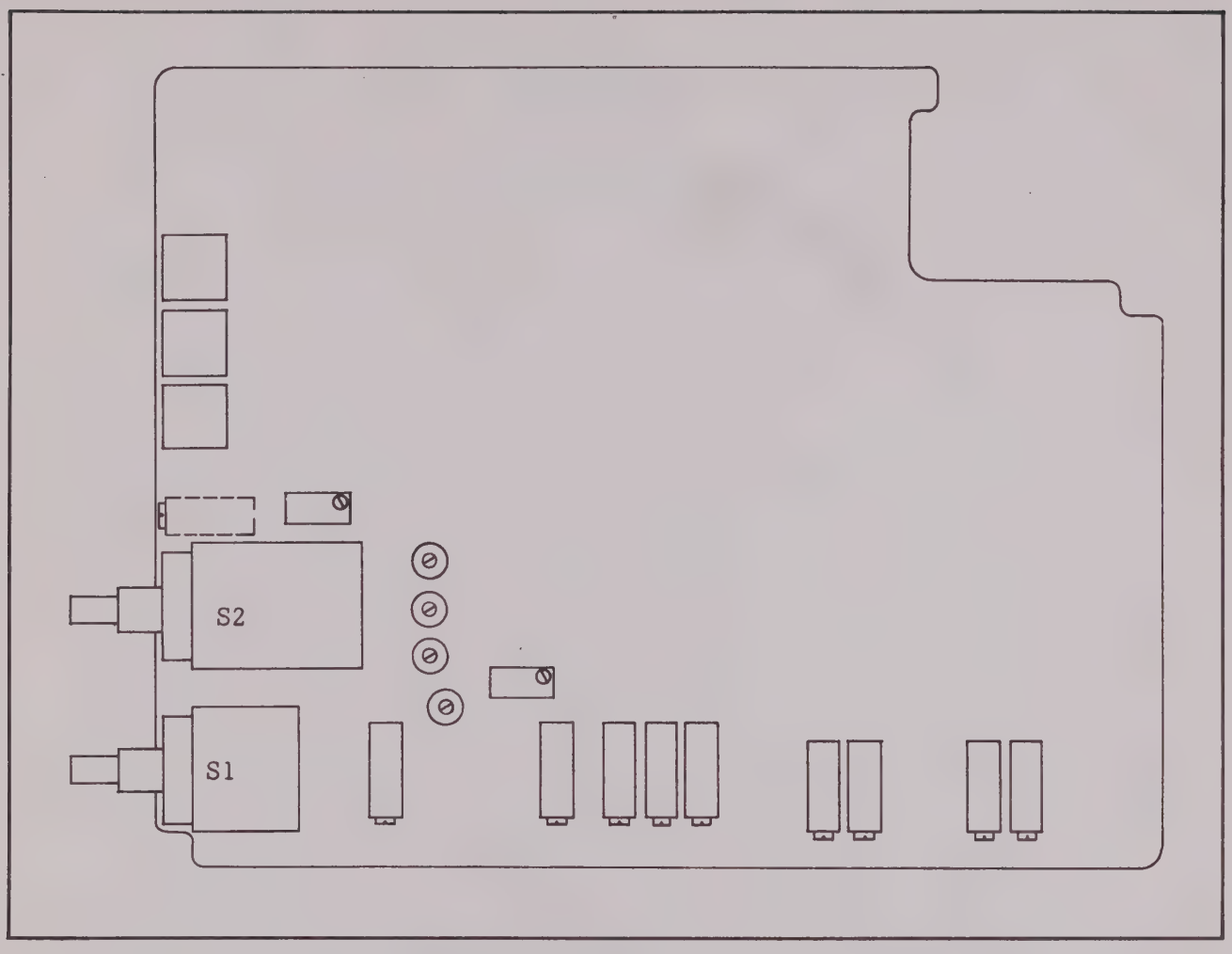


Table 5.5 - 2000 Volt Range Check

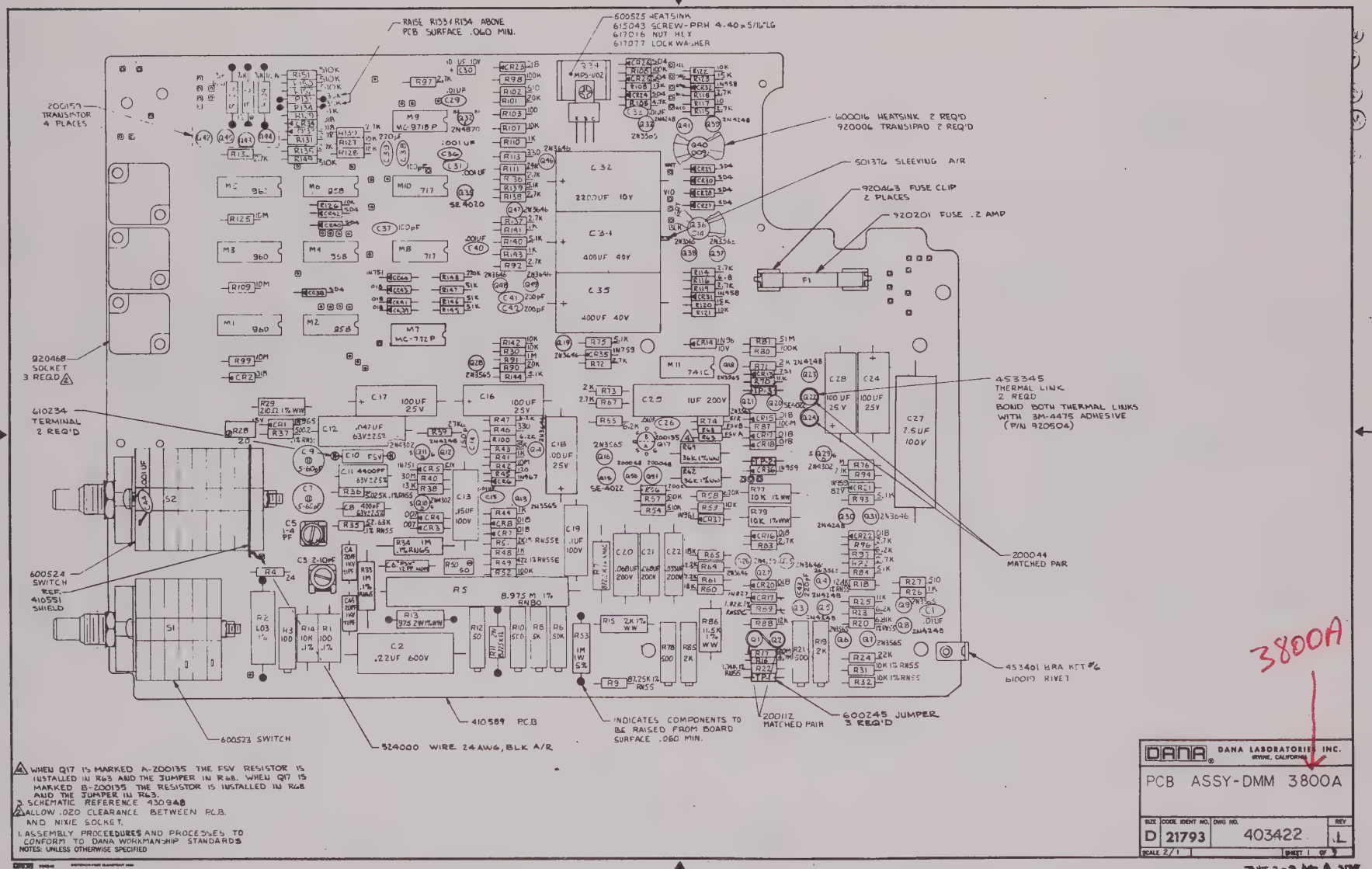
FUNCTION	RANGE	INPUT	ADJUST	DISPLAY	REMARKS
VDC	2000	+1000	–	+1000	± 4 digits
VDC	2000	-1000	–	-1000	± 4 digits

SECTION 6

DRAWINGS

6.1 DRAWINGS.

PCB Assembly – DMM 3800A	403422
Schematic – DMM 3800A	430948
PCB Assembly – DMM 3860A	403315
Schematic – DMM 3860A	430909
Module Assembly 3800A-E	403336
Module Assembly 3860A-E	403339
Case Assembly	403299
Option 1 – DMM Assembly	400955
PCB Assembly Option 1	403337
Schematic Option 1	430914
Connector Assembly	403338



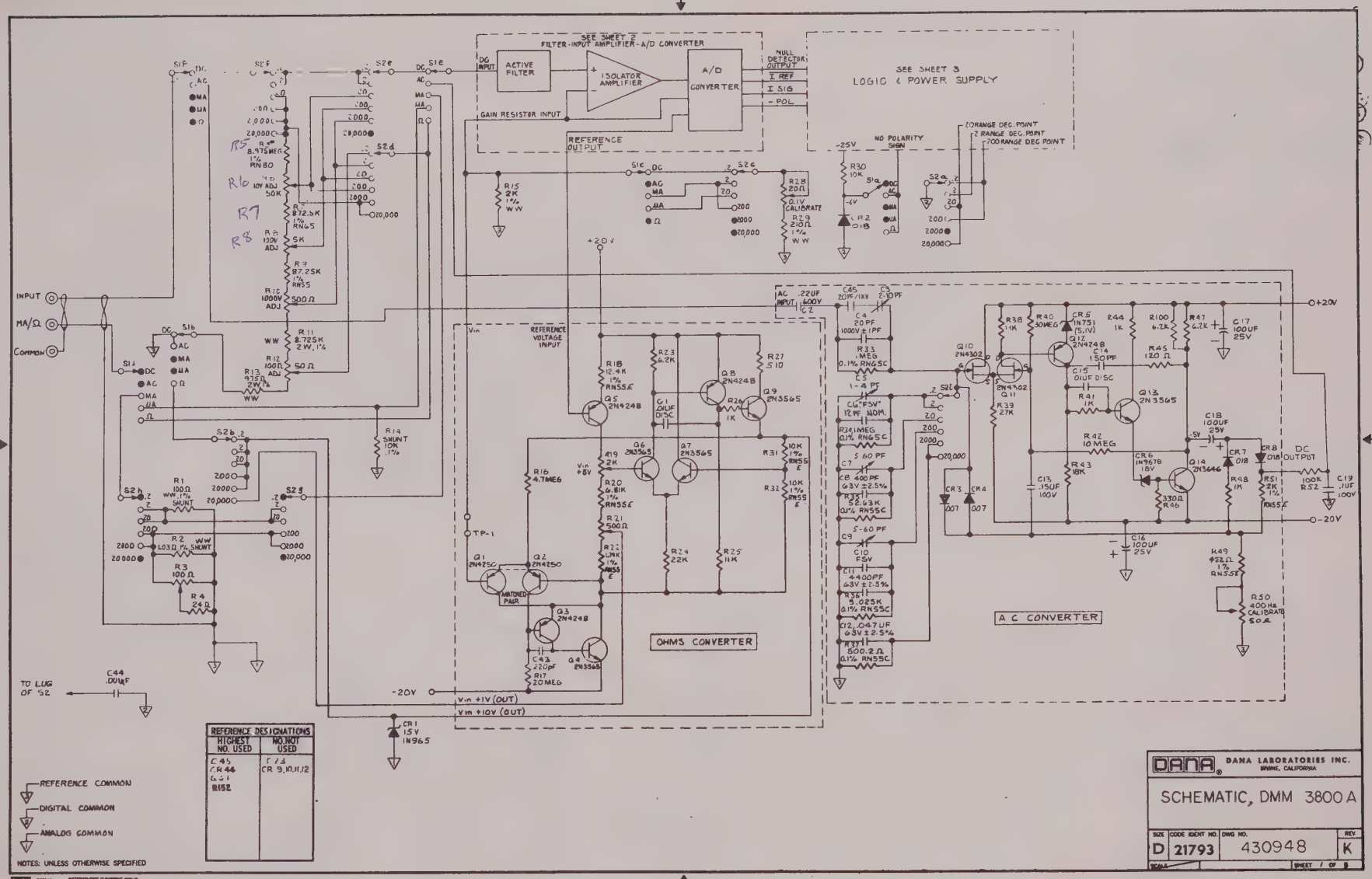
⚠4 WHEN Q17 IS MARKED A-200135 THE FSV RESISTOR IS INSTALLED IN R63 AND THE JUMPER IN R68. WHEN Q17 IS MARKED B-200135 THE RESISTOR IS INSTALLED IN R68 AND THE JUMPER IN R63.

3 SCHEMATIC REFERENCE 430948

⚠2 ALLOW .020 CLEARANCE BETWEEN PCB AND NIXIE SOCKET.

1. ASSEMBLY PROCEEDURES AND PROCESSES TO CONFORM TO DANA WORKMANSHIP STANDARDS

NOTES: UNLESS OTHERWISE SPECIFIED



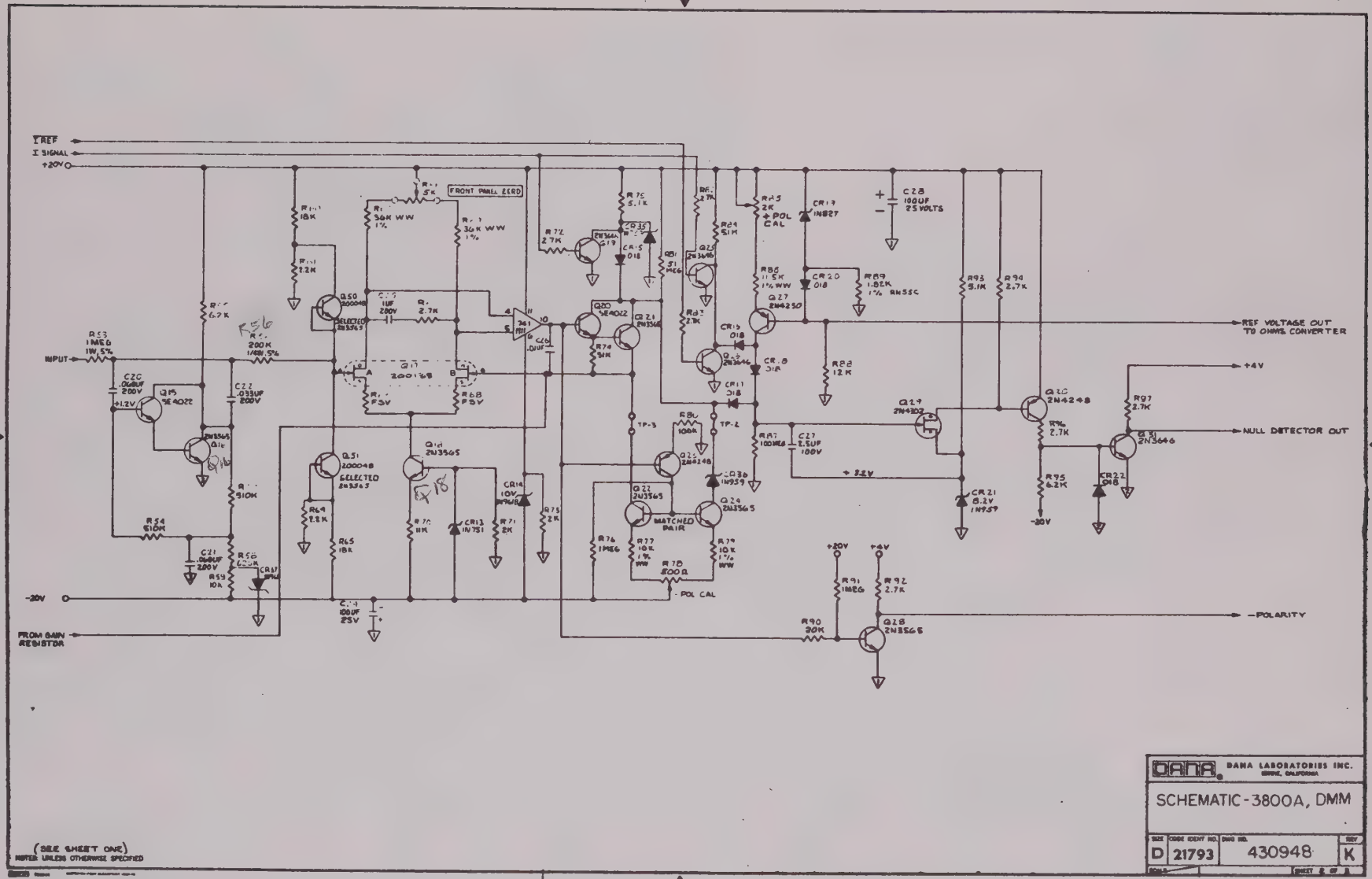
REFERENCE DESIGNATIONS	
HIGHEST NO. USED	NO. NOT USED
C45 CR44 G41 R152	C13 CR 9,10,11,12

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

SCHEMATIC, DMM 3800 A

SIZE	CODE IDENT NO.	DWG NO.	REV
D	21793	430948	K

SCALE | SHEET 1 OF 3



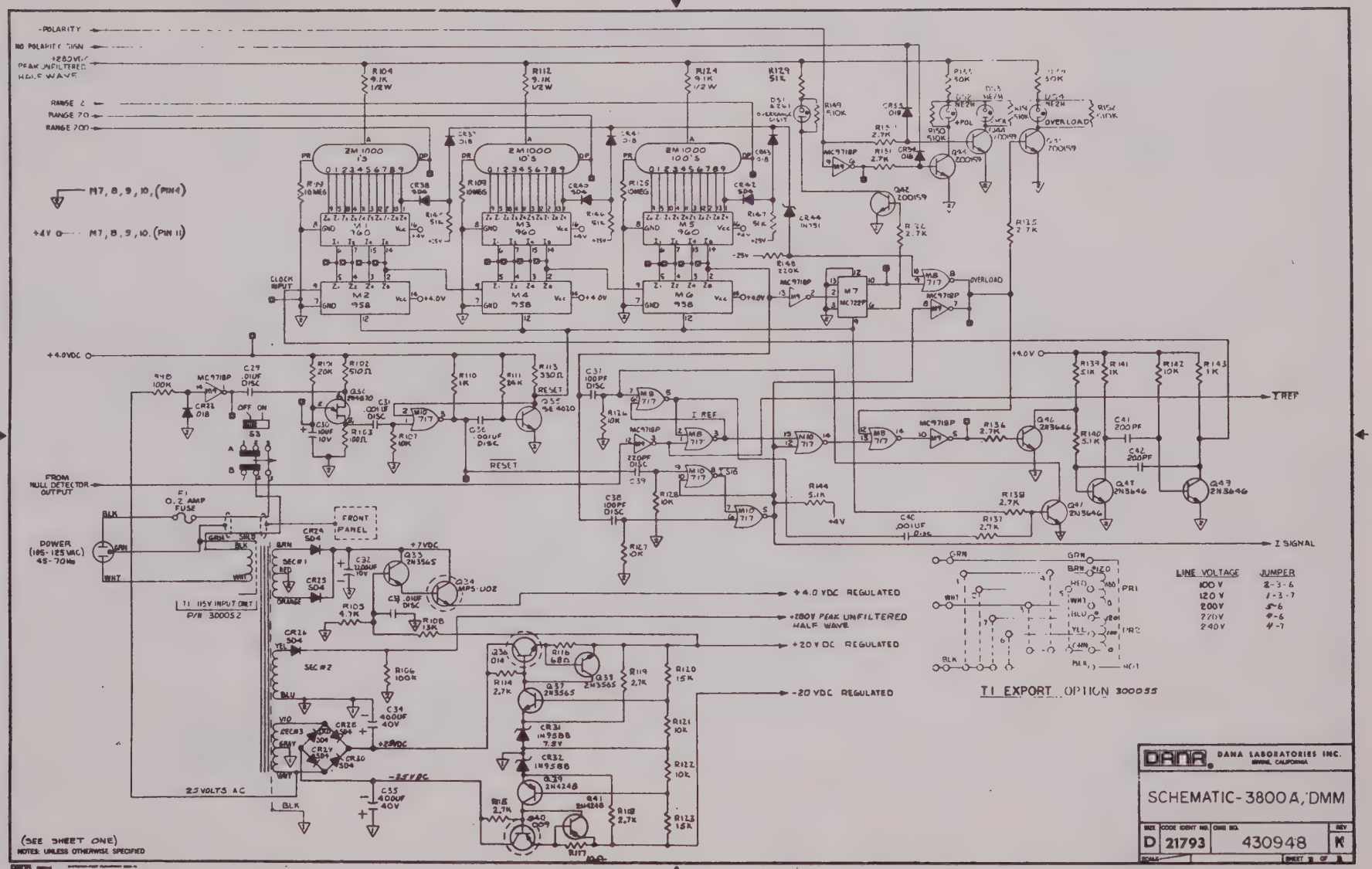
(SEE SHEET ONE)
NOTES UNLESS OTHERWISE SPECIFIED

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

SCHEMATIC - 3800A, DMM

SIZE	CODE IDENT NO.	DWG NO.	REV
D	21793	430948	K

SCALE | SHEET 2 OF 3



DANA LABORATORIES INC.
IRVINE, CALIFORNIA

SCHEMATIC - 3800A, DMM

SIZE	CODE IDENT NO.	DWG NO.	REV
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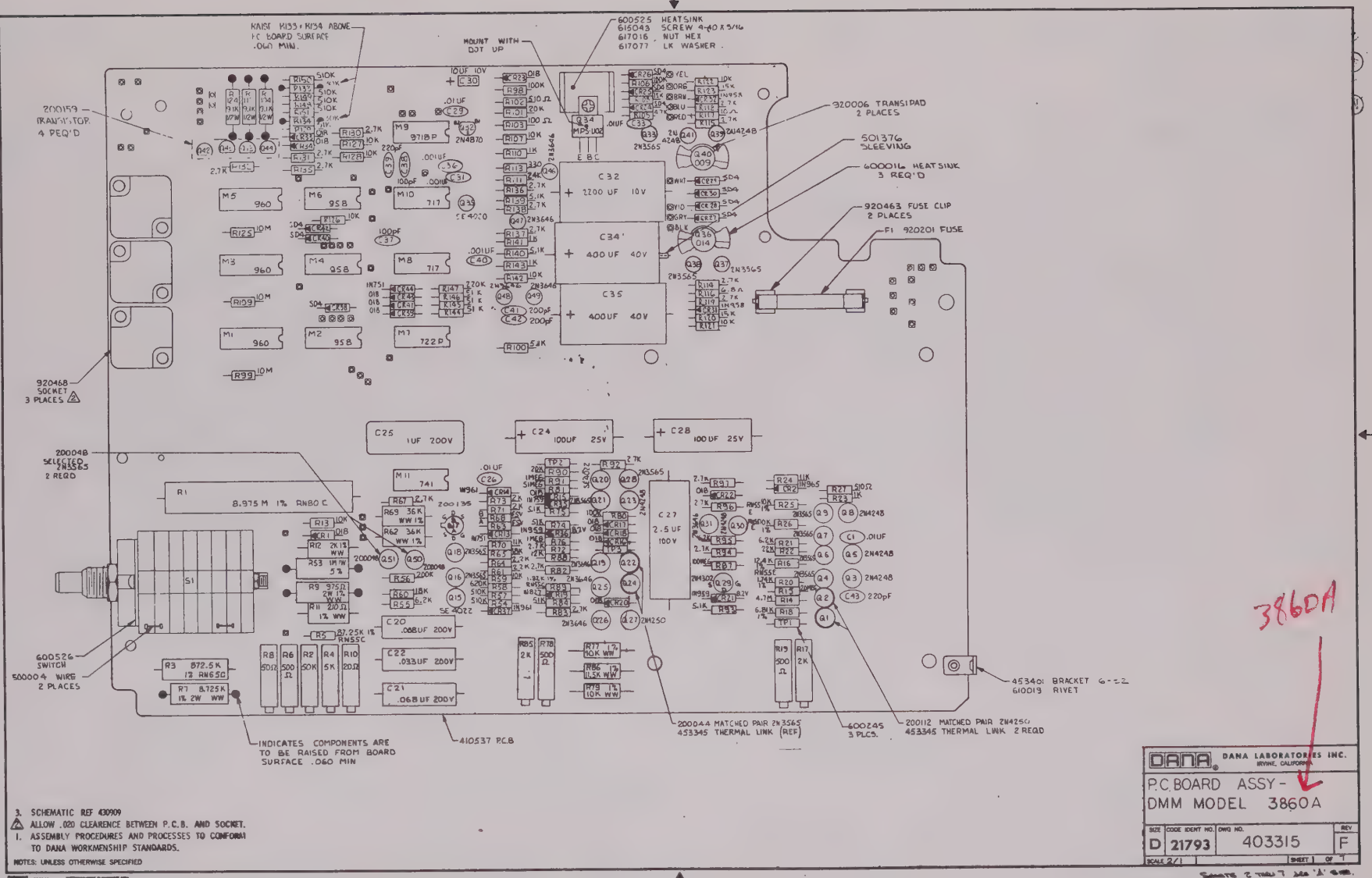
SCALE — SHEET 1 OF 1



3860A

3. SCHEMATIC REF 430909
⚠ ALLOW .020 CLEARENCE BETWEEN P.C.B. AND SOCKET.
1. ASSEMBLY PROCEDURES AND PROCESSES TO CONFORM TO DANA WORKMENSHIP STANDARDS.

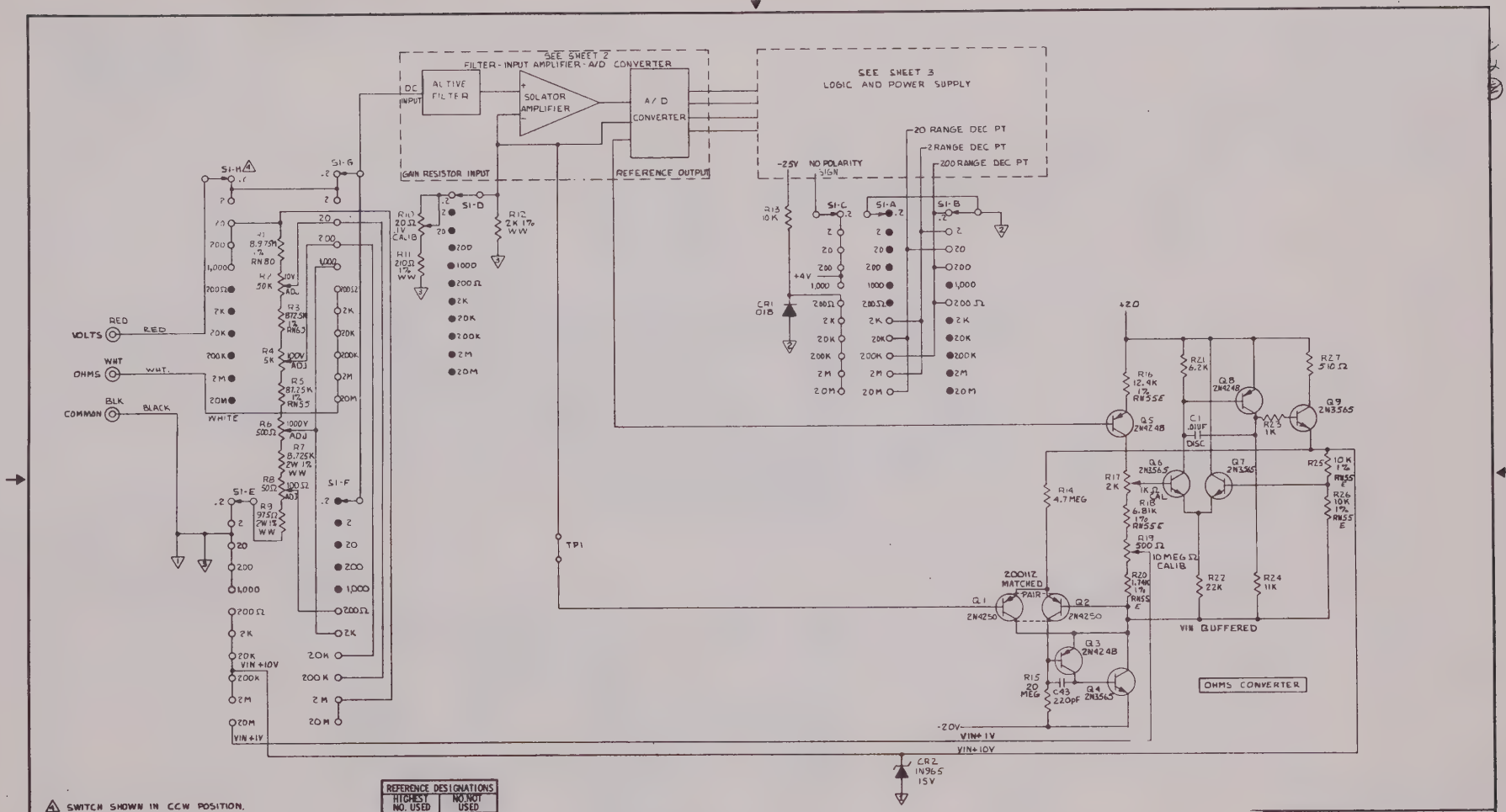
NOTES: UNLESS OTHERWISE SPECIFIED

DANA DANA LABORATORIES INC. IRVINE, CALIFORNIA

P.C. BOARD ASSY - DMM MODEL 3860A

SIZE	CODE IDENT NO.	DWG NO.	REV
D	21793	403315	F

SCALE 2/1 SHEET 1 OF 1



REFERENCE DESIGNATIONS	
HIGHEST NO. USED	NO. NOT USED
C-43	C-2 THRU 19
CR-44	CR-3 THRU 12
Q-51	Q-10 THRU 19
R-131	RZ8 THRU 52

⚠ SWITCH SHOWN IN CCW POSITION.

REFERENCE COMMON

DIGITAL COMMON

ANALOG COMMON

NOTES: UNLESS OTHERWISE SPECIFIED

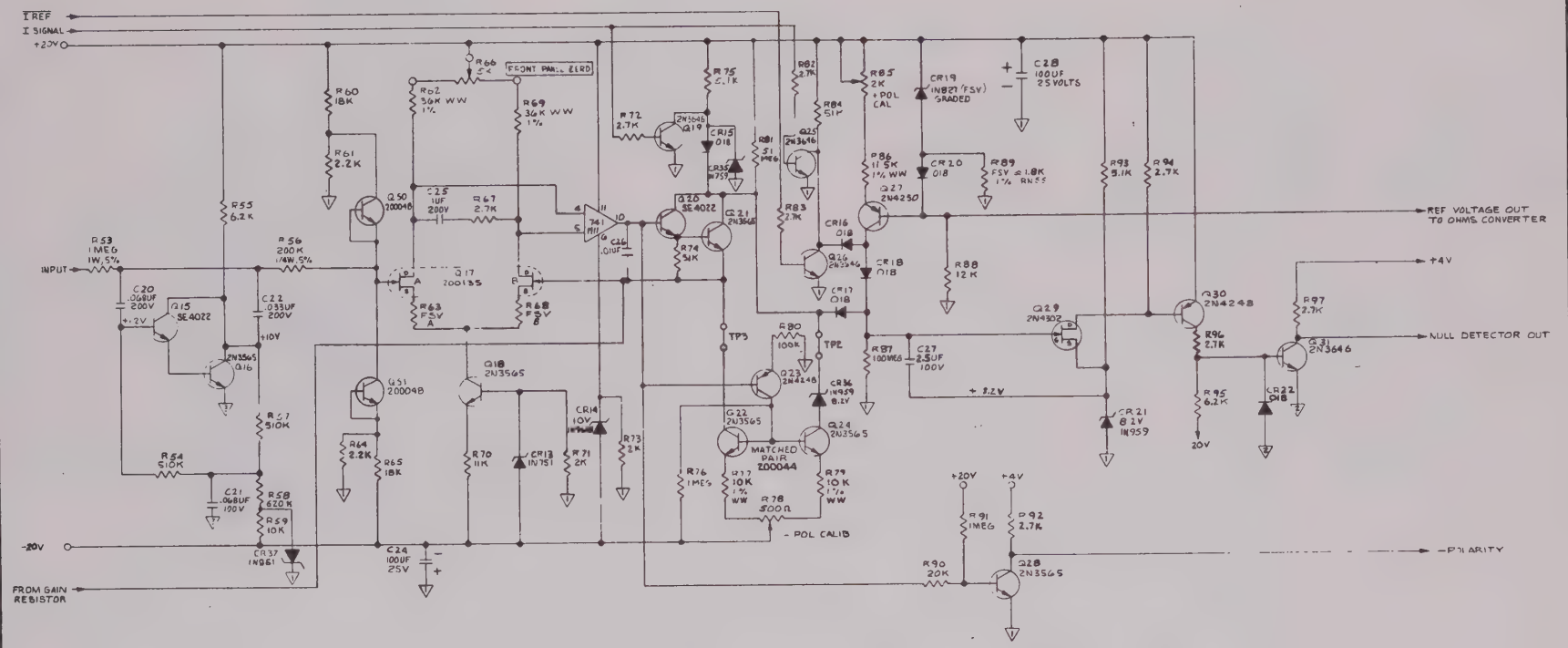
DANA DANA LABORATORIES INC. IRVINE, CALIFORNIA

SCHEMATIC DMM 3860A

SIZE	CODE IDENT NO.	DWG NO.	REV
D	21793	430909	E

SCALE

SHEET 1 OF 3



(SEE SHEET ONE)
NOTES: UNLESS OTHERWISE SPECIFIED

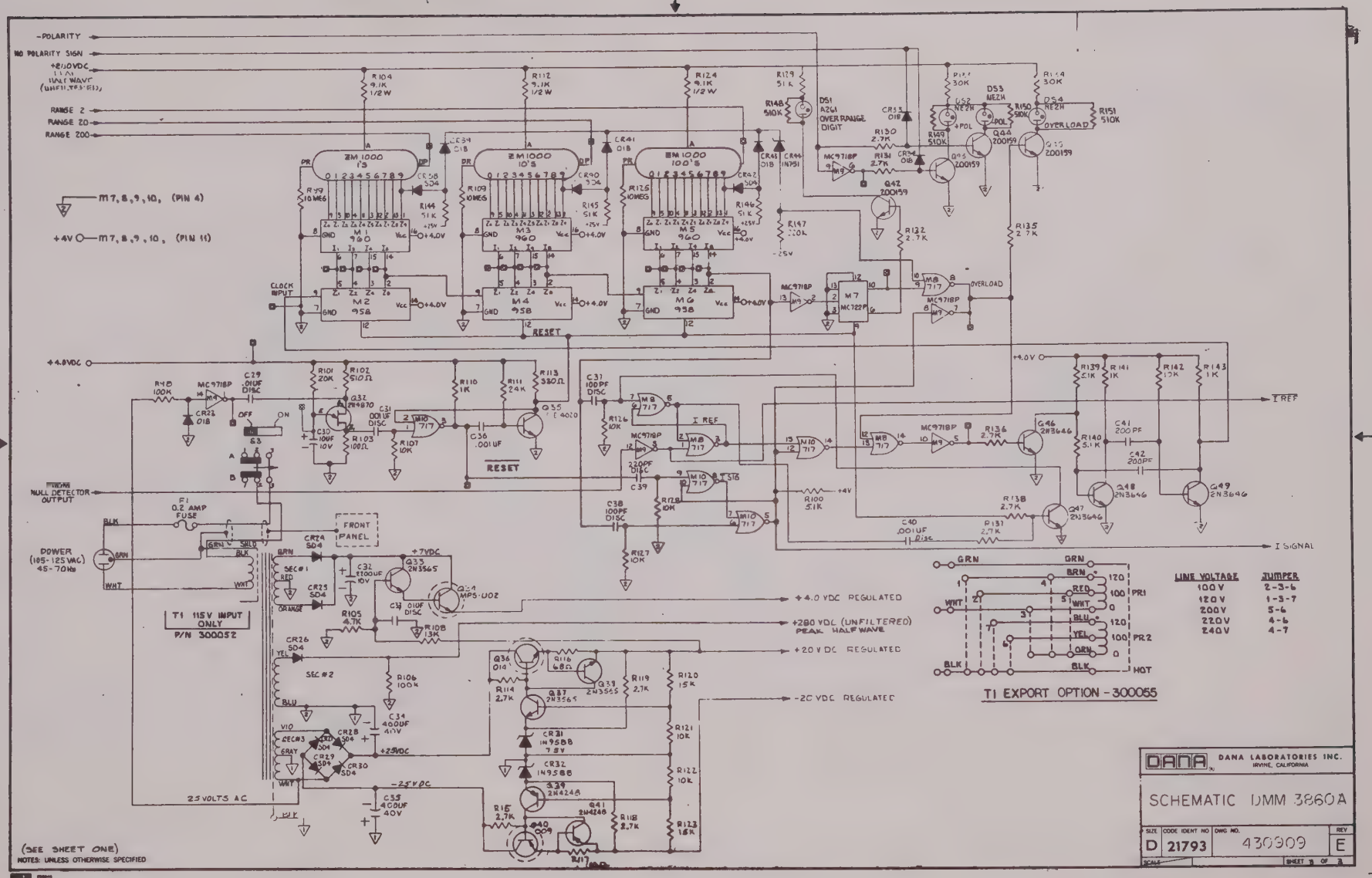
DANA DANA LABORATORIES INC.
IRVINE, CALIFORNIA

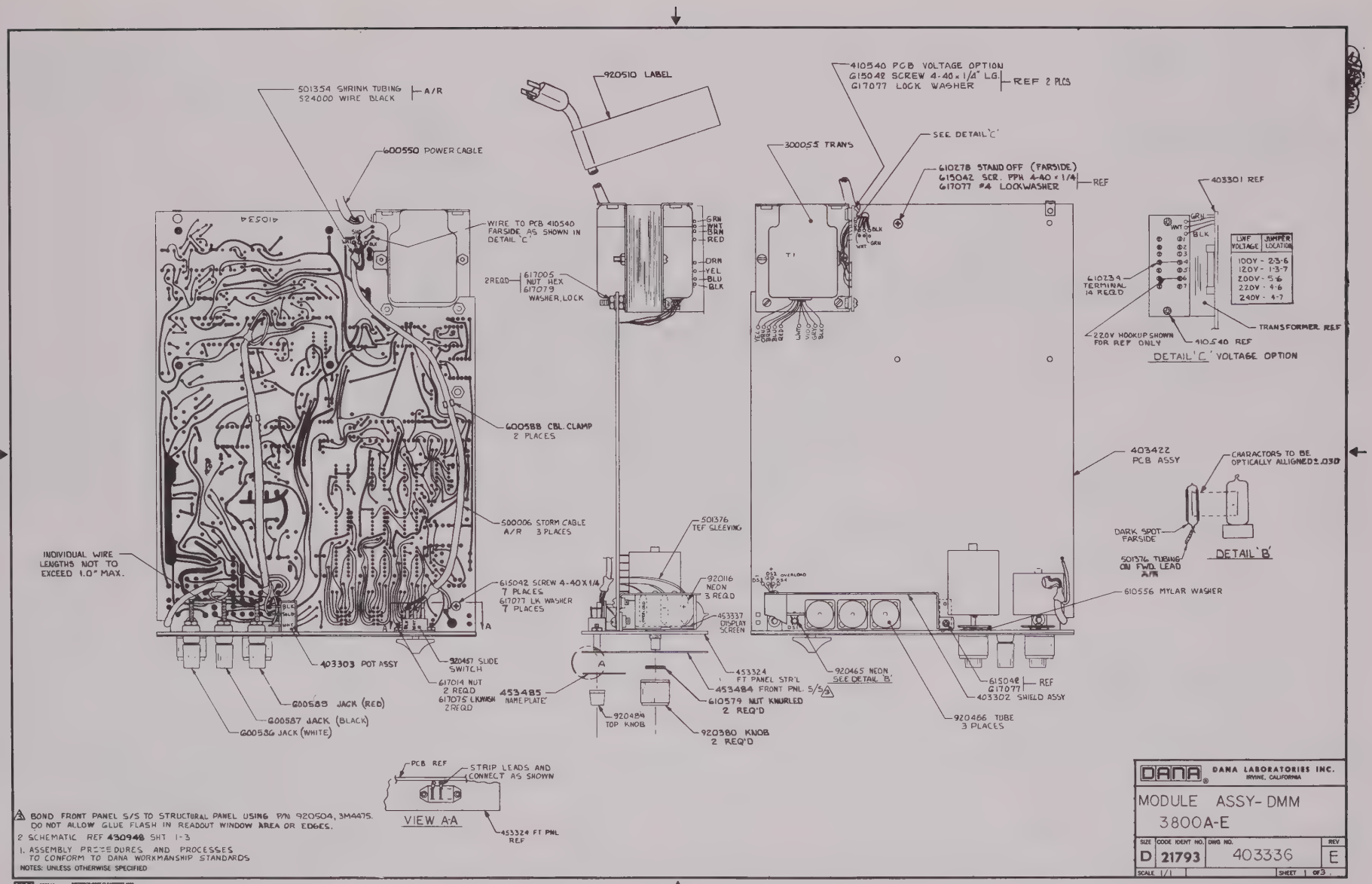
SCHEMATIC, DMM 3860 A

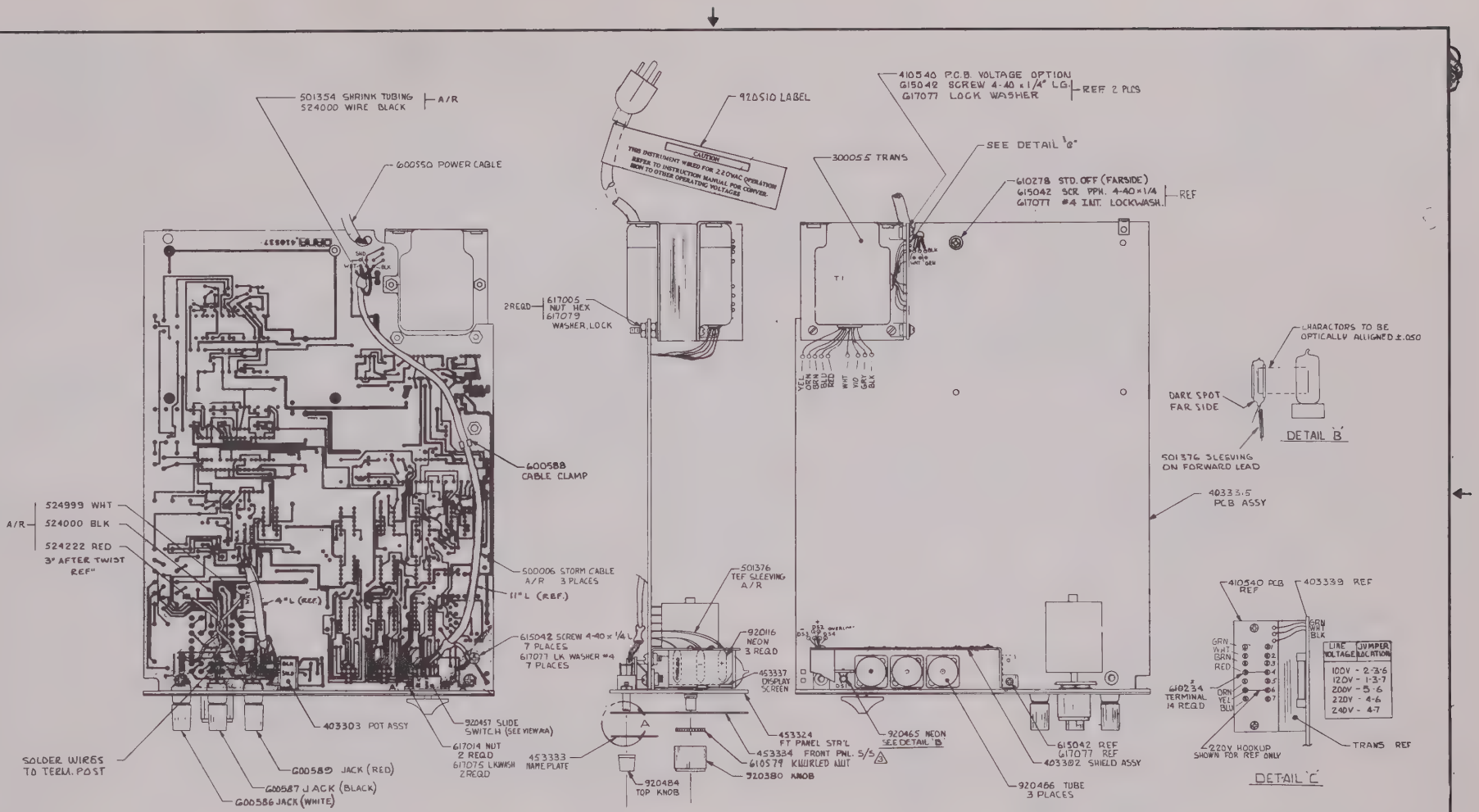
SIZE	CODE IDENT NO	DWG NO.	REV
D	21793	430909	E

SCALE

SHEET 2 OF 3


-POLARITY
NO POLARITY SIGN
+2.0VDC
RANGE 2
RANGE 20
RANGE 200
ZM1000 1'S
ZM1000 10'S
ZM1000 100'S
CLOCK INPUT
RESET
+4.8VDC
NULL DETECTOR OUTPUT
POWER (105-125 VAC) 45-70Hz
F1 0.2 AMP FUSE
FRONT PANEL
T1 115V INPUT ONLY P/N 300052
25 VOLTS AC
+4.0 VDC REGULATED
+280 VDC (UNFILTERED) PEAK HALF WAVE
+20 V DC REGULATED
-20 VDC REGULATED
I REF
I SIGNAL
OVERLOAD
T1 EXPORT OPTION - 300055
LINE VOLTAGE
JUMPER
100 V 2-3-6
120 V 1-3-7
200 V 5-6
220 V 4-6
240 V 4-7
(SEE SHEET ONE)
NOTES: UNLESS OTHERWISE SPECIFIED
DANA LABORATORIES INC.
IRVINE, CALIFORNIA
SCHEMATIC DMM 3860A
SIZE D
CODE IDENT NO 21793
DWG NO. 430909
REV E
SHEET 3 OF 3


501354 SHRINK TUBING
S24000 WIRE BLACK
A/R
600550 POWER CABLE
920510 LABEL
410540 PCB VOLTAGE OPTION
615042 SCREW 4-40 x 1/4" LG.
617077 LOCK WASHER
REF 2 PLCS
SEE DETAIL 'C'
300055 TRANS
610278 STAND OFF (FARSIDE)
615042 SCR. PPH 4-40 x 1/4
617077 #4 LOCKWASHER
REF
403301 REF
WIRE TO PCB 410540 FARSIDE AS SHOWN IN DETAIL 'C'
2 REQD
617005 NUT HEX
617079 WASHER, LOCK
600588 CBL. CLAMP
2 PLACES
500006 STORM CABLE
A/R 3 PLACES
INDIVIDUAL WIRE LENGTHS NOT TO EXCEED 1.0" MAX.
615042 SCREW 4-40 X 1/4
7 PLACES
617077 LK WASHER
7 PLACES
403303 POT ASSY
920457 SLIDE SWITCH
617014 NUT
2 REQD
617075 LKWASH
2 REQD
453485 NAME PLATE
600583 JACK (RED)
600587 JACK (BLACK)
600536 JACK (WHITE)
501376 TEF SLEEVING
920116 NEON
3 REQD
453337 DISPLAY SCREEN
453324 FT PANEL STR'L
453484 FRONT PNL. 5/5
610579 NUT KNURLED
2 REQ'D
920484 TOP KNOB
920380 KNOB
2 REQ'D
920465 NEON
SEE DETAIL 'B'
920466 TUBE
3 PLACES
615042 REF
617077 REF
403302 SHIELD ASSY
610556 MYLAR WASHER
403422 PCB ASSY
CHARACTORS TO BE OPTICALLY ALLIGNED ±.030
DARK SPOT FARSIDE
501376 TUBING ON FWD. LEAD A/R
DETAIL 'B'
610273 TERMINAL 14 REQ'D
220V HOOKUP SHOWN FOR REF ONLY
410540 REF
TRANSFORMER REF
LINE VOLTAGE
JUMPER LOCATION
100V - 2-3-6
120V - 1-3-7
200V - 5-6
220V - 4-6
240V - 4-7
DETAIL 'C' VOLTAGE OPTION
PCB REF
STRIP LEADS AND CONNECT AS SHOWN
VIEW A-A
453324 FT PNL REF
BOND FRONT PANEL S/S TO STRUCTURAL PANEL USING P/N 920504, 3M4475. DO NOT ALLOW GLUE FLASH IN READOUT WINDOW AREA OR EDGES.
2 SCHEMATIC REF 430948 SHT 1-3
1. ASSEMBLY PROCEDURES AND PROCESSES TO CONFORM TO DANA WORKMANSHIP STANDARDS
NOTES: UNLESS OTHERWISE SPECIFIED
DANA LABORATORIES INC.
IRVINE, CALIFORNIA
MODULE ASSY- DMM
3800A-E
SIZE D
CODE IDENT NO. 21793
DWG NO. 403336
REV E
SCALE 1/1
SHEET 1 OF 3



⚠ BOND FRONT PNL S/S TO STRUCTURAL PANEL USING 920504 - DO NOT ALLOW GLUE FLASH IN READOUT WINDOW AREA OR EDGES.

2 SCHEMATIC REF 430909

1. ASSEMBLY PROCEADURES AND PROCESSES TO CONFORM TO DANA WORKMENSHIP STANDARDS

NOTES: UNLESS OTHERWISE SPECIFIED

DANA DANA LABORATORIES INC.

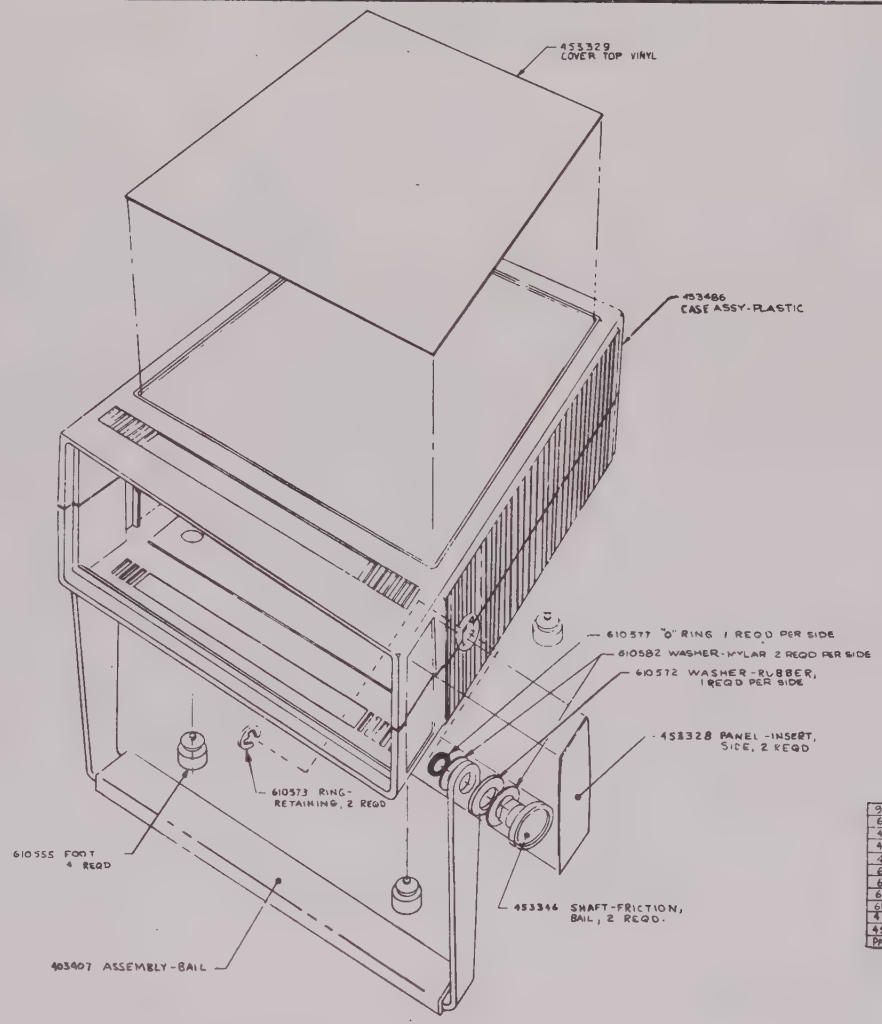
MODULE ASSY-DMM

3860A-E

SIZE	CODE IDENT NO.	DWG NO.	REV
D	21793	403339	C

SCALE 1/1 SHEET 1 OF 3

Sheets 2 & 3 Rel 21 3 REF



PART NO.	DESCRIPTION	QTY
920504	CEMENT	A/R
610582	WASHER-MYLAR	4
453329	COVER - TOP	1
453486	CASE ASSY- PLASTIC	1
403407	ASSEMBLY - BAIL	1
610577	"O" RING	2
610573	RING - RETAINING	2
610572	WASHER - NEOPRENE	2
610555	FOOT	4
453346	SHAFT - FRICTION, BAIL	2
453328	PANEL - INSERT, SIDE	2

6. RETAINING RING TO BOW TOWARDS SIDE OF CASE WHEN INSTALLED.
5. FINISHED CASE ASSY TO BE PACKED IN SHIPPING CARTON 920302.
4. BOND TOP COVER TO CASE USING 920504. BONDED COVER SHALL LIE FLAT WITH CORNERS, EDGES AND CENTER FIRMLY BONDED.
3. SIDE INSERTS SHALL BE PRESSED FIRMLY IN PLACE SO THAT NO EDGE OR CORNER IS UNBONDED. THEY SHALL NOT EXHIBIT ANY CREASES SCRATCHES, WAVINESS, OR DISCOLORATION.
2. FEET SHOULD BE INSERTED INTO HOLES UNTIL INNER FLANGE IS COMPLETELY VISIBLE INSIDE CASE.
1. ASSEMBLY PROCEDURES AND PROCESSES TO CONFORM TO DANA WORKMANSHIP STANDARDS.

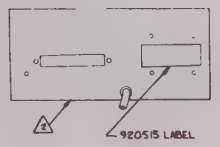
NOTE: UNLESS OTHERWISE SPECIFIED

DANA DANA LABORATORIES INC.
IRVINE, CALIFORNIA

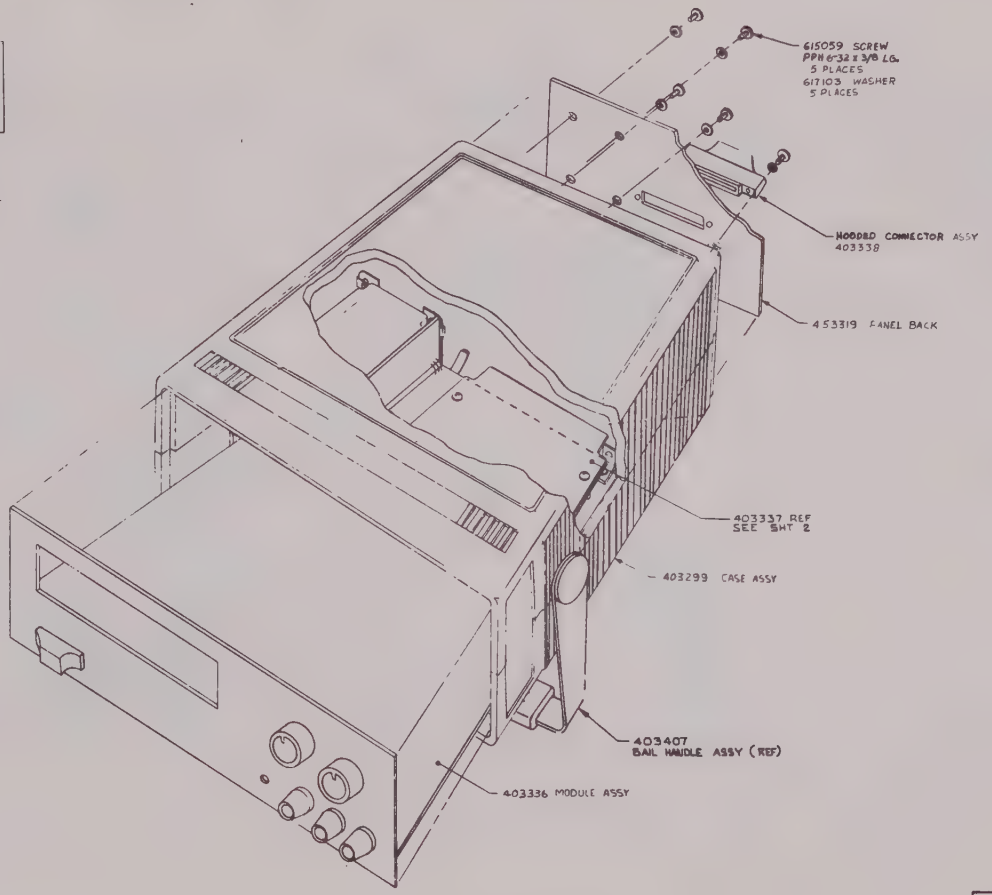
CASE ASSY DMM 3800

SIZE	CODE IDENT NO.	DWG NO.	REV
D	21793	403299	A

SHEET 1 OF 2 - A SIZE

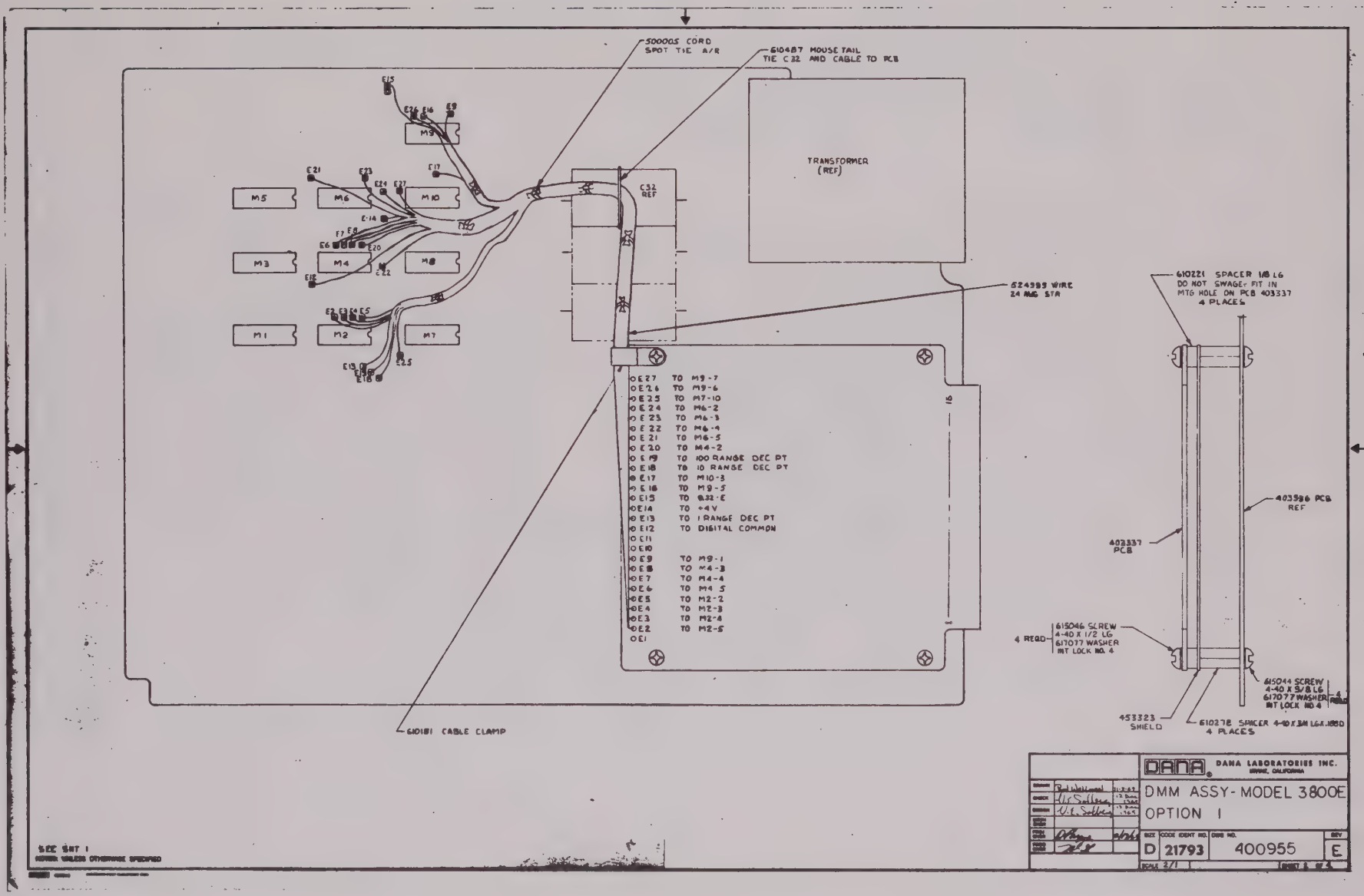


REAR PANEL DETAIL



⚠ LOCATE SERIAL NO. TAG (920515) ON BOTTOM REAR OF CASE.
1. ASSEMBLY PROCEADURES AND PROCESSES TO CONFORM TO DANA WORKMENSHIP STANDARDS.
NOTES UNLESS OTHERWISE SPECIFIED

	DANA LABORATORIES INC. IRVINE, CALIFORNIA		
DRAWN			DMM ASSY - MODEL 3800E
CHECK			(EXPORT) OPTION 1
DESIGN			
MECH ENGR			
PROJ ENGR			
PROD ENGR			
SIZE	CODE IDENT NO	DWG NO.	REV
D	21793	400955	E
SCALE		SHT 1 OF 4	


500005 CORD SPOT TIE A/R
610487 MOUSE TAIL TIE C32 AND CABLE TO PCB
TRANSFORMER (REF)
C32 REF
524383 WIRE 24 AWG STR
610181 CABLE CLAMP
E27 TO M9-7
E26 TO M9-6
E25 TO M7-10
E24 TO M6-2
E23 TO M6-3
E22 TO M6-4
E21 TO M6-5
E20 TO M4-2
E19 TO 100 RANGE DEC PT
E18 TO 10 RANGE DEC PT
E17 TO M10-3
E16 TO M9-5
E15 TO C32-E
E14 TO +4V
E13 TO 1 RANGE DEC PT
E12 TO DIGITAL COMMON
E11
E10
E9 TO M9-1
E8 TO M4-3
E7 TO M4-4
E6 TO M4-5
E5 TO M2-2
E4 TO M2-3
E3 TO M2-4
E2 TO M2-5
E1
610221 SPACER 1/8 LG DO NOT SWAGE FIT IN MTG HOLE ON PCB 403337 4 PLACES
403986 PCB REF
402337 PCB
4 REQD
615046 SCREW 4-40 X 1/2 LG 617077 WASHER INT LOCK NO 4
615044 SCREW 4-40 X 3/8 LG 617077 WASHER INT LOCK NO 4
453323 SHIELD
610278 SPACER 4-40 X 3/8 LG X .188D 4 PLACES

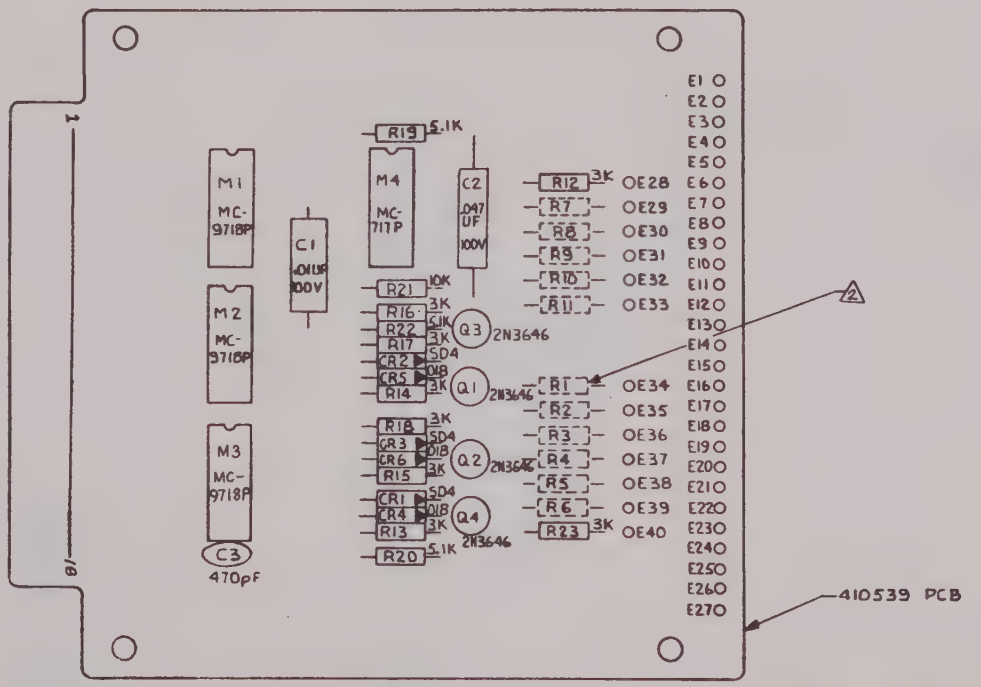
SEE SHT 1

DANA DANA LABORATORIES INC. IRVINE, CALIFORNIA

DMM ASSY- MODEL 3800E OPTION 1

SIZE	CODE IDENT NO.	DWG NO.	REV
D	21793	400955	E

SCALE 2/1 SHEET 1 OF 2



2 R1 THRU R11 ARE NOT INSTALLED ON THIS ASSY. CIRCUITRY AND HOLES ARE PROVIDED FOR SPECIAL APPLICATION. SEE SCHEMATIC 403914 FOR INSTRUCTIONS.

1 ASSEMBLY PROCEDURES AND PROCESSES TO CONFORM TO DANA WORKMANSHIP STANDARDS.

NOTES: UNLESS OTHERWISE SPECIFIED

NEXT DWG	USED ON	NEXT DWG	FINAL ASSY
400953	3800E OPT 1	1	1
400954	3800 OPT 1	1	1
APPLICATION		QTY REQD	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES AND INCLUDE THICKNESS OF PLATING

TOLERANCES

DECIMALS	ANGLES	HOLE DIAMETERS
X.030	0° 30'	+.004
XX.020	FORMED	-.001
XXX.010	1° 0'	

DIMENSIONS AND TOLERANCES PER USAS Y14.15

MATERIAL | FINISH

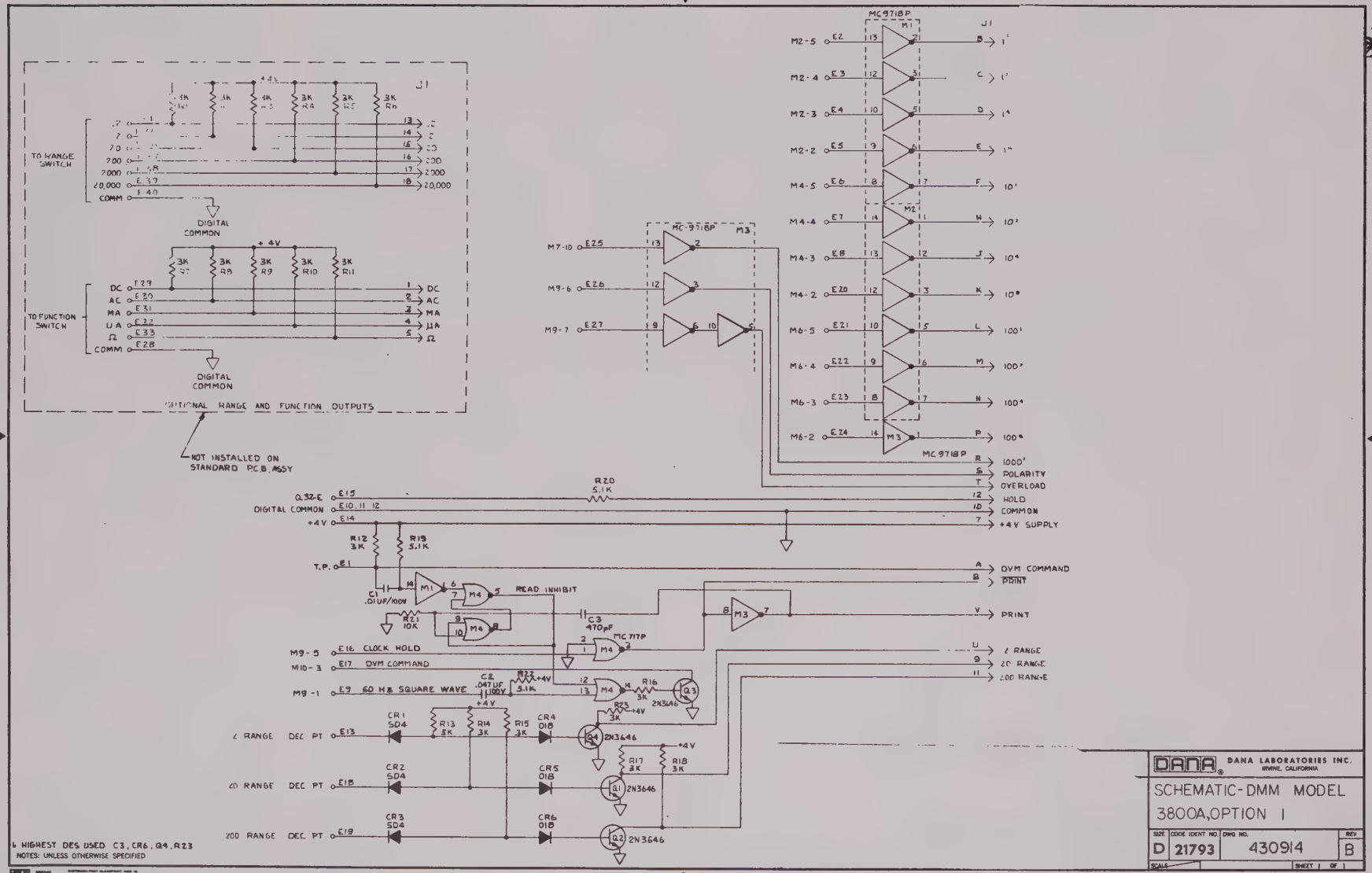
DRAWN	Paul Wellman	12-3-69
CHECK	W. Solberg	
DESIGN	W. E. Solberg	4 DEC 1969
MECH ENGR		
PROJ ENGR	D Payne	4/4/69
PROD ENGR	W. Griffith	10/19

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

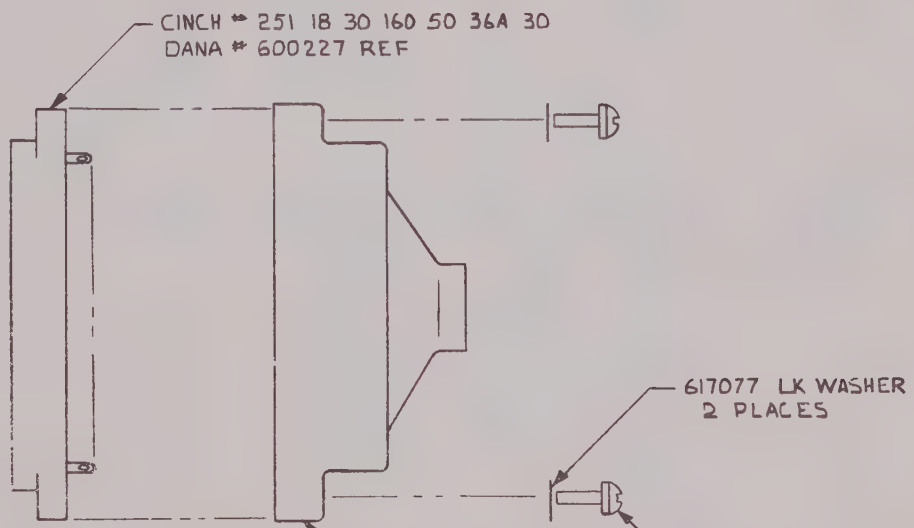
P.C.BOARD ASSY- OUTPUT OPTION 1

SIZE	CODE IDENT NO.	DWG NO.	REV
C	21793	403337	A

SCALE 2/1 SHEET 1 OF 3


OPTIONAL RANGE AND FUNCTION OUTPUTS
NOT INSTALLED ON STANDARD P.C.B. ASSY
TO RANGE SWITCH
TO FUNCTION SWITCH
DIGITAL COMMON
+4V
J1
MC9718P
M1
M2
M3
M4
MC717P
DIGITAL COMMON
+4V SUPPLY
COMMON
HOLD
OVERLOAD
POLARITY
1000'
DVM COMMAND
PRINT
READ INHIBIT
CLOCK HOLD
60 Hz SQUARE WAVE
2N3646
SD4
018
.2 RANGE DEC PT
20 RANGE DEC PT
200 RANGE DEC PT
.2 RANGE
20 RANGE
200 RANGE
4 HIGHEST DES USED C3, CR6, Q4, R23
NOTES: UNLESS OTHERWISE SPECIFIED
DANA LABORATORIES INC.
IRVINE, CALIFORNIA
SCHEMATIC-DMM MODEL 3800A, OPTION 1
SIZE D
CODE IDENT NO. 21793
DWG NO. 430914
REV B
SCALE
SHEET 1 OF 1

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED
A	REL. PER DRN. NO. 944	12-24-69	[illegible]



NEXT DWG	USED ON	NEXT DWG	FINAL ASSY
400957	38600P1	1	1
400959	3800 OPT. 1	1	1
APPLICATION		QTY REQD	

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON:
DECIMALS: X .030, XX .020, XXX .010 | ANGLES: 0° 30', FORMED 1° 0' | HOLE DIAMETERS: - .004, - .001

MATERIAL

FINISH

DRAWN	R. Wellman	11-22-69
CHECK	N. Sadberry	12-24-69
DESIGN	R. Wellman	11-22-69
MECH ENGR		
PROJ ENGR	D. Payne	12/19/69
	W. Stubble	12/19/69

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

HOODED CONNECTOR ASSY.

SIZE	CODE IDENT NO	DWG NO.	REV
B	21793	403338	A

SCALE 1/1 SHEET 1 OF 2

⚠ ASSEMBLY PROCEDURES AND PROCESSES TO CONFORM TO DANA WORKMANSHIP STANDARDS.

NOTES: UNLESS OTHERWISE SPECIFIED

PARTS LIST

ASSEMBLY 403422 DMM MODEL 3800A

A

REF. DESIG.	PART NO.	DESCRIPTION	
CR01	220022	DIODE SILICO ZENER 1N965B	MOTOROLA 1N965B
CR02	211083	DIODE SILICO 018	DANA 211083
CR03	211236	DIODE SILICO 007	DANA 211236
CR04	211236	DIODE SILICO 007	DANA 211236
CR05	220007	DIODE SILICO ZENER 1N751	MOTOROLA 1N751
CR06	220015	DIODE SILICO ZENER 1N967B	MOTOROLA 1N967B
CR07	211083	DIODE SILICO 018	DANA 211083
CR08	211083	DIODE SILICO 018	DANA 211083
CR13	220007	DIODE SILICO ZENER 1N751	MOTOROLA 1N751
CR14	220004	DIODE SILICO ZENER 1N961B	MOTOROLA 1N961B
CR15	211083	DIODE SILICO 018	DANA 211083
CR16	211083	DIODE SILICO 018	DANA 211083
CR17	211083	DIODE SILICO 018	DANA 211083
CR18	211083	DIODE SILICO 018	DANA 211083
CR19	220045	DIODE SILICO ZENER 1N827	SEMCOR 1N827
CR20	211083	DIODE SILICO 018	DANA 211083
CR21	220038	DIODE SILICO ZENER 1N959B	MOTOROLA 1N959B
CR22	211083	DIODE SILICO 018	DANA 211083
CR23	211083	DIODE SILICO 018	DANA 211083
CR24	210004	DIODE SILICO SD4	DIODES IN SD4
CR25	210004	DIODE SILICO SD4	DIODES IN SD4
CR26	210004	DIODE SILICO SD4	DIODES IN SD4
CR27	210004	DIODE SILICO SD4	DIODES IN SD4
CR28	210004	DIODE SILICO SD4	DIODES IN SD4
CR29	210004	DIODE SILICO SD4	DIODES IN SD4
CR30	210004	DIODE SILICO SD4	DIODES IN SD4
CR31	220012	DIODE SILICO ZENER 1N958B	MOTOROLA 1N958B
CR32	220012	DIODE SILICO ZENER 1N958B	MOTOROLA 1N958B
CR33	211083	DIODE SILICO 018	DANA 211083
CR34	211083	DIODE SILICO 018	DANA 211083
CR35	220029	DIODE SILICO ZENER 1N759A	MOTOROLA 1N759A
CR36	220038	DIODE SILICO ZENER 1N959B	MOTOROLA 1N959B
CR37	220004	DIODE SILICO ZENER 1N961B	MOTOROLA 1N961B
CR38	210004	DIODE SILICO SD4	DIODES IN SD4
CR39	211083	DIODE SILICO 018	DANA 211083
CR40	210004	DIODE SILICO SD4	DIODES IN SD4
CR41	211083	DIODE SILICO 018	DANA 211083
CR42	210004	DIODE SILICO SD4	DIODES IN SD4
CR43	211083	DIODE SILICO 018	DANA 211083

PARTS LIST

ASSEMBLY 403422 DMM MODEL 3800A A

REF. DESIG.	PART NO.	DESCRIPTION					
CR44	22C007	DIODE SILICO ZENER 1N751				MOTOROLA	1N751
C01	100017	CAP	CERAM	.01 MFD 200 V	10%	SPRAGUE	TH-S10
C02	120007	CAP	MYLAR	.22 MFD 600 V	20%	ELEC CUBE	210B1F224
C03	130077	CAP		1.8 pF 500 V		AMPEREX	2222-809-05002
C04	120197	CAP	POLYS	20 PFD1000 V		DUCATI	20-1000
C05	130109	CAP		1.4 pF		AMPEREX	2222-809-05001
C06	120198	CAP	POLY	12 PFD 500 V	20%	MALLORY	SX412
C07	130055	CAP	CERAM	5-60 PFD	10%	AMPREX	C010MA/60E
C08	120165	CAP	POLYS	400 PFD 63 V	2.5%	MIAL	611
C09	101175	CAP	CERAM	220 PFD 500 V	10%	AEROVOX	SCD1X5F
C09	130055	CAP	CERAM	5-60 PFD	10%	AMPREX	C010MA/60E
C10	120142	CAP	POLYS	FSV		DANA	120142
C11	120162	CAP	POLYS	.0044 MFD 63 V	2.5%	MIAL	611.2D
C12	120161	CAP	POLYS	.047 MFD 63 V	2.5%	DIEL	N100
C13	121394	CAP	MYLAR	.15 MFD 100 V	10%	CDE	WMF1P15
C14	101642	CAP	CERAM	150 PFD 500 V	10%	AEROVOX	SCD2X5F
C15	100017	CAP	CERAM	.01 MFD 200 V	10%	SPRAGUE	TH-S10
C16	111148	CAP	ELECT	100 MFD 25 V	20%	SPRAGUE	TE1211
C17	111148	CAP	ELECT	100 MFD 25 V	20%	SPRAGUE	TE1211
C18	111148	CAP	ELECT	100 MFD 25 V	20%	SPRAGUE	TE1211
C19	120003	CAP	MYLAR	.1 MFD 100 V	10%	CDE	WMF1P1
C20	120216	CAP	MYLAR	.068 MFD 200 V		CDE	WMF2S68
C21	120216	CAP	MYLAR	.068 MFD 200 V	10%	CDE	WMF 2S68
C22	120211	CAP	MYLAR	.033 MFD 200 V		CDE	WMF2S33
C24	111148	CAP	ELECT	100 MFD 25 V	20%	SPRAGUE	TE1211
C25	120134	CAP	MYLAR	1 MFD 200 V	10%	PAKTRON	MF1200LL
C26	100017	CAP	CERAM	.01 MFD 200 V	10%	SPRAGUE	TH-S10
C27	110122	CAP		2.5 MFD 100 V		IMB	ZA28255J
C28	111148	CAP	ELECT	100 MFD 25 V	20%	SPRAGUE	TE1211
C29	100017	CAP	CERAM	.01 MFD 200 V	10%	SPRAGUE	TH-S10
C30	110069	CAP	ELEC	10 MFD 10 V		KEMET	K10W10K
C31	101174	CAP	CERAM	.001 MFD 500 V	10%	AEROVOX	SCD3X5F
C32	110121	CAP	ELECT	2200 MFD 10 V		AMPEREX	ET222X010A03
C33	100017	CAP	CERAM	.01 MFD 200 V	10%	SPRAGUE	TH-S10
C34	110112	CAP	ELECT	400 MFD 40 V		AMPEREX	C437ARG400
C35	110112	CAP	ELECT	400 MFD 40 V		AMPEREX	C437ARG400
C36	101174	CAP	CERAM	.001 MFD 500 V	10%	AEROVOX	SCD3X5F

PARTS LIST

ASSEMBLY 403422 DMM MODEL 3800A A

REF. DESIG.	PART NO.	DESCRIPTION			
C37	101145	CAP CERAM 100 PFD 500 V	10%	AEROVOX	SCD1X5F
C38	101145	CAP CERAM 100 PFD 500 V	10%	AEROVOX	SCD1X5F
C40	101174	CAP CERAM .001 MFD 500 V	10%	AEROVOX	SCD3X5F
C41	101644	CAP CERAM 200 PFD 500 V	20%	AEROVOX	GPDX5F201K
C42	101644	CAP CERAM 200 PFD 500 V	20%	AEROVOX	GPDX5F201K
C43	101175	CAP CERAM 220 PFD 500 V	10%	AEROVOX	SCD1X5F
C44	101174	CAP CERAM .001 MFD 500 V	10%	AEROVOX	SCD3X5F
M01	230014	INTEGRATED CIRCUIT UL9960		FAIRCHILD	UL9960
M02	230049	INTEGRATED CIRCUIT CUL9958		FAIRCHILD	CUL9958
M03	230014	INTEGRATED CIRCUIT UL9960		FAIRCHILD	UL9960
M04	230049	INTEGRATED CIRCUIT CUL9958		FAIRCHILD	CUL9958
M05	230014	INTEGRATED CIRCUIT UL9960		FAIRCHILD	UL9960
M06	230049	INTEGRATED CIRCUIT CUL9958		FAIRCHILD	CUL9958
M07	230058	INTEGRATED CIRCUIT MC722P		MOTOROLA	MC722P
M08	230002	INTERGRATED CIRCUIT MC717		MOTOROLA	MC717
M09	230057	INTEGRATED CIRCUIT MC9718P		MOTOROLA	MC9718P
M10	230002	INTERGRATED CIRCUIT MC717		MOTOROLA	MC717
M11	230045	INTEGRATED CIRCUIT UA741C		FAIRCHILD	UA741C
Q01	200112	TRANS SILICO DUAL FSV		DANA	200112
Q02	200112	TRANS SILICO DUAL FSV		DANA	200112
Q03	200088	TRANS SILICO PNP 2N4248		FAIRCHILD	2N4248
Q04	200043	TRANS SILICO NPN 2N3565		FAIRCHILD	2N3565
Q05	200088	TRANS SILICO PNP 2N4248		FAIRCHILD	2N4248
Q06	200043	TRANS SILICO NPN 2N3565		FAIRCHILD	2N3565
Q07	200043	TRANS SILICO NPN 2N3565		FAIRCHILD	2N3565
Q08	200088	TRANS SILICO PNP 2N4248		FAIRCHILD	2N4248
Q09	200043	TRANS SILICO NPN 2N3565		FAIRCHILD	2N3565
Q10	200107	TRANS SILICO 2N4302		INTERSIL	2N4302
Q11	200107	TRANS SILICO 2N4302		INTERSIL	2N4302
Q12	200088	TRANS SILICO PNP 2N4248		FAIRCHILD	2N4248
Q13	200043	TRANS SILICO NPN 2N3565		FAIRCHILD	2N3565
Q14	200037	TRANS SILICO NPN 2N3646		FAIRCHILD	2N3646
Q15	200136	TRANS SE4022		FAIRCHILD	SE4022
Q16	200043	TRANS SILICO NPN 2N3565		FAIRCHILD	2N3565
Q17	200135	TRANS SILICO SELECTED		DANA	200135
Q18	200043	TRANS SILICO NPN 2N3565		FAIRCHILD	2N3565
Q19	200037	TRANS SILICO NPN 2N3646		FAIRCHILD	2N3646
Q20	200136	TRANS SE4022		FAIRCHILD	SE4022
Q21	200043	TRANS SILICO NPN 2N3565		FAIRCHILD	2N3565
Q22	200044	TRANS SILICO NPN DUAL FSV		DANA	200044

PARTS LIST

ASSEMBLY 403422 DMM MODEL 3800A A

REF. DESIG.	PART NO.	DESCRIPTION		
Q23	200088	TRANS SILICO PNP	2N4248	FAIRCHILD 2N4248
Q24	200044	TRANS SILICO NPN DUAL	FSV	DANA 200044
Q25	200037	TRANS SILICO NPN	2N3646	FAIRCHILD 2N3646
Q26	200037	TRANS SILICO NPN	2N3646	FAIRCHILD 2N3646
Q27	200068	TRANS	2N4250	FAIRCHILD 2N4250
Q28	200043	TRANS SILICO NPN	2N3565	FAIRCHILD 2N3565
Q29	200107	TRANS SILICO	2N4302	INTERSIL 2N4302
Q30	200088	TRANS SILICO PNP	2N4248	FAIRCHILD 2N4248
Q31	200037	TRANS SILICO NPN	2N3646	FAIRCHILD 2N3646
Q32	200075	TRANS	2N4870	MOTOROLA 2N4870
Q33	200043	TRANS SILICO NPN	2N3565	FAIRCHILD 2N3565
Q34	200111	TRANS SILICO	MPSU02	MOTOROLA MPSU02
Q35	200129	TRANS SILICO	SE4020	FAIRCHILD SE4020
Q36	200035	TRANS SILICO NPN	014	DANA 200035
Q37	200043	TRANS SILICO NPN	2N3565	FAIRCHILD 2N3565
Q38	200043	TRANS SILICO NPN	2N3565	FAIRCHILD 2N3565
Q39	200088	TRANS SILICO PNP	2N4248	FAIRCHILD 2N4248
Q40	200011	TRANS SILICO PNP	009	DANA 200011
Q41	200088	TRANS SILICO PNP	2N4248	FAIRCHILD 2N4248
Q42	200159	TRANS		DANA 200159
Q43	200159	TRANS		DANA 200159
Q44	200159	TRANS		DANA 200159
Q45	200159	TRANS		DANA 200159
Q46	200037	TRANS SILICO NPN	2N3646	FAIRCHILD 2N3646
Q47	200037	TRANS SILICO NPN	2N3646	FAIRCHILD 2N3646
Q48	200037	TRANS SILICO NPN	2N3646	FAIRCHILD 2N3646
Q49	200037	TRANS SILICO NPN	2N3646	FAIRCHILD 2N3646
Q50	200048	TRANS SILICO NPN DUAL	2N3565	DANA 200048
Q51	200048	TRANS SILICO NPN DUAL	2N3565	DANA 200048
R01	020568	RES WW	100 OHMS .1%	C-F F155
R02	020561	RES WW	1.03 OHMS 1%	C-F M30
R03	040175	RES VARI	100 OHMS 10%	SPECTROL 41-2-1-101
R04	000240	RES CARBON	24 OHM 5% 1/4 W	OHMITE RC07GF240J
R05	010484	RES METAL	8.975 MEG 1%	IRC RN80C
R06	040172	RES VARI	50K	SPECTROL 41-2-1-503
R07	010485	RES METAL	872.5K 1%	IRC RN65C
R08	040173	RES VARI	5K	SPECTROL 41-2-1-502
R09	010486	RES METAL	87.25K 1%	IRC RN55C
R10	040174	RES VARI	500 OHM	SPECTROL 41-2-1-501

PARTS LIST

ASSEMBLY 403422 DMM MODEL 3800A A

REF. DESIG.	PART NO.	DESCRIPTION					
R11	020562	RES WW	8.725K	1%	2W	C-F	M30
R12	040176	RES VARI	50 OHM			SPECTROL	41-2-1-500
R13	020563	RES WW	975 OHMS	1%	2W	C-F	M19
R14	020567	RES WW	10K	.1%		C-F	F155
R15	020572	RES WW	2K	1%		C-F	M19
R16	000475	RES CARBON	4.7 M	5%	1/4 W	OHMITE	RC07GF475J
R17	000206	RES CARBON	20 M	5%	1/4 W	OHMITE	RC07GF206J
R18	010488	RES METAL	12.4K	1%		IRC	RN55E
R19	040112	RES VARI	2 K			BECKMAN	79PR2K
R20	010492	RES METAL	12.4K	1%		IRC	RN55E
R21	040174	RES VARI	500 OHM			SPECTROL	41-2-1-501
R22	010493	RES METAL	1.74K	1%		IRC	RN55E
R23	000622	RES CARBON	6.2 K	5%	1/4 W	OHMITE	RC07GF622J
R24	000223	RES CARBON	22 K	5%	1/4 W	OHMITE	RC07GF223J
R25	000113	RES CARBON	11 K	5%	1/4 W	OHMITE	RC07GF113J
R26	000102	RES CARBON	1 K	5%	1/4 W	OHMITE	RC07GF102J
R27	000511	RES CARBON	510 OHM	5%	1/4 W	OHMITE	RC07GF511J
R28	040128	RES VARI	20 OHM			SPECTROL	50-3-1-200
R29	020575	RES WW	210 OHM	1%	2W	C-F	M19
R30	000103	RES CARBON	10 K	5%	1/4 W	OHMITE	RC07GF103J
R31	010490	RES METAL	10 K	1%		IRC	RN55E
R32	010490	RES METAL	10 K	1%		IRC	RN55E
R33	010479	RES METAL	1 MEG	.1%		IRC	RN65C
R34	010479	RES METAL	1 MEG	.1%		IRC	RN65C
R35	010483	RES METAL	52.63 K	.1%		IRC	RN55C
R36	010482	RES METAL	5.025 K	.1%		IRC	RN55C
R37	010481	RES METAL	500.2 K	.1%		IRC	RN55C
R38	000133	RES CARBON	13 K	5%	1/4 W	OHMITE	RC07GF133J
R39	000273	RES CARBON	27 K	5%	1/4 W	OHMITE	RC07GF273J
R40	000306	RES CARBON	30 M	5%	1/4 W	OHMITE	RC07GF306J
R41	000102	RES CARBON	1 K	5%	1/4 W	OHMITE	RC07GF102J
R42	000106	RES CARBON	10 M	5%	1/4 W	OHMITE	RC07GF106J
R43	000183	RES CARBON	18 K	5%	1/4 W	OHMITE	RC07GF183J
R44	000102	RES CARBON	1 K	5%	1/4 W	OHMITE	RC07GF102J
R45	000121	RES CARBON	120 OHM	5%	1/4 W	OHMITE	RC07GF121J
R46	000331	RES CARBON	330 OHM	5%	1/4 W	OHMITE	RC07GF331J
R47	000622	RES CARBON	6.2 K	5%	1/4 W	OHMITE	RC07GF622J

PARTS LIST

ASSEMBLY 403422 DMM MODEL 3800A A

REF. DESIG.	PART NO.	DESCRIPTION						
R48	000102	RES	CARBON	1 K	5%	1/4 W	OHMITE	RC07GF102J
R49	010552	RES	METAL	422 OHM	1%		IRC	RN55E
R50	040108	RES	VARI	50 OHM			SPECTROL	50-3
R51	010530	RES	METAL	2 K	1%		IRC	RN55E
R52	000104	RES	CARBON	100 K	5%	1/4 W	OHMITE	RC07GF104J
R53	001762	RES	CARBON	1 MEG	5%	1 W	OHMITE	RC32GF105J
R54	000514	RES	CARBON	510 K	5%	1/4 W	OHMITE	RC07GF524J
R55	000622	RES	CARBON	6.2 K	5%	1/4 W	OHMITE	RC07GF622J
R56	000204	RES	CARBON	200 K	5%	1/4 W	OHMITE	RC07GF204J
R57	000514	RES	CARBON	510 K	5%	1/4 W	OHMITE	RC07GF524J
R58	000624	RES	CARBON	620 K	5%	1/4 W	OHMITE	RC07GF624J
R59	000103	RES	CARBON	10 K	5%	1/4 W	OHMITE	RC07GF103J
R60	000183	RES	CARBON	18 K	5%	1/4 W	OHMITE	RC07GF183J
R61	000222	RES	CARBON	2.2 K	5%	1/4 W	OHMITE	RC07GF222J
R62	020566	RES	WW	36 K	1%		C-F	F155
R63	200135	TRANS	SILICO	SELECTED			DANA	200135
R64	000222	RES	CARBON	2.2 K	5%	1/4 W	OHMITE	RC07GF222J
R65	000183	RES	CARBON	18 K	5%	1/4 W	OHMITE	RC07GF183J
R67	000272	RES	CARBON	2.7 K	5%	1/4 W	OHMITE	RC07GF272J
R68	200135	TRANS	SILICO	SELECTED			DANA	200135
R69	020566	RES	WW	36 K	1%		C-F	F155
R70	000113	RES	CARBON	11 K	5%	1/4 W	OHMITE	RC07GF113J
R71	000202	RES	CARBON	2 K	5%	1/4 W	OHMITE	RC07GF202J
R72	000272	RES	CARBON	2.7 K	5%	1/4 W	OHMITE	RC07GF272J
R73	000202	RES	CARBON	2 K	5%	1/4 W	OHMITE	RC07GF202J
R74	000513	RES	CARBON	51 K	5%	1/4 W	OHMITE	RC07GF513J
R75	000512	RES	CARBON	5.1 K	5%	1/4 W	OHMITE	RC07GF512J
R76	000105	RES	CARBON	1 M	5%	1/4 W	OHMITE	RC07GF105J
R77	020580	RES	WW	10 K	1%	2 W	C-F	M19
R78	040174	RES	VARI	500 OHM			SPECTROL	41-2-1-501
R79	020580	RES	WW	10 K	1%	2 W	C-F	M19
R80	000104	RES	CARBON	100 K	5%	1/4 W	OHMITE	RC07GF104J
R81	000516	RES	CARBON	51 M	5%	1/4 W	OHMITE	RC07GF516J
R82	000272	RES	CARBON	2.7 K	5%	1/4 W	OHMITE	RC07GF272J
R83	000272	RES	CARBON	2.7 K	5%	1/4 W	OHMITE	RC07GF272J
R84	000513	RES	CARBON	51 K	5%	1/4 W	OHMITE	RC07GF513J
R85	040112	RES	VARI	2 K			BECKMAN	79PR2K
R86	020574	RES	WW	11.5 K	1%	2 W	C-F	M19
R87	000107	RES	CARBON	100 M	5%	1/4 W	OHMITE	RC07GF107J

PARTS LIST

ASSEMBLY 403422 DMM MODEL 3800A A

REF. DESIG.	PART NO.	DESCRIPTION							
R88	000123	RES	CARBON	12 K	5%	1/4 W		OHMITE	RC07GF123J
R89	010555	RES	METAL	1.82 K	1 %			IRC	RN55C
R90	000203	RES	CARBON	20 K	5%	1/4 W		OHMITE	RC07GF203J
R91	000105	RES	CARBON	1 M	5%	1/4 W		OHMITE	RC07GF105J
R92	000272	RES	CARBON	2.7 K	5%	1/4 W		OHMITE	RC07GF272J
R93	000512	RES	CARBON	5.1 K	5%	1/4 W		OHMITE	RC07GF512J
R94	000272	RES	CARBON	2.7 K	5%	1/4 W		OHMITE	RC07GF272J
R95	000622	RES	CARBON	6.2 K	5%	1/4 W		OHMITE	RC07GF622J
R96	000272	RES	CARBON	2.7 K	5%	1/4 W		OHMITE	RC07GF272J
R97	000272	RES	CARBON	2.7 K	5%	1/4 W		OHMITE	RC07GF272J
R98	000104	RES	CARBON	100 K	5%	1/4 W		OHMITE	RC07GF104J
R99	000106	RES	CARBON	10 M	5%	1/4 W		OHMITE	RC07GF106J
R100	000622	RES	CARBON	6.2 K	5%	1/4 W		OHMITE	RC07GF622J
R101	000203	RES	CARBON	20 K	5%	1/4 W		OHMITE	RC07GF203J
R102	000511	RES	CARBON	510 OHM	5%	1/4 W		OHMITE	RC07GF511J
R103	000101	RES	CARBON	100 OHM	5%	1/4 W		OHMITE	RC07GF101J
R104	001102	RES	CARBON	9.1 K	5%	1/2 W		OHMITE	RC20GF912J
R105	000472	RES	CARBON	4.7 K	5%	1/4 W		OHMITE	RC07GF472J
R106	000104	RES	CARBON	100 K	5%	1/4 W		OHMITE	RC07GF104J
R107	000103	RES	CARBON	10 K	5%	1/4 W		OHMITE	RC07GF103J
R108	000133	RES	CARBON	13 K	5%	1/4 W		OHMITE	RC07GF133J
R109	000106	RES	CARBON	10 M	5%	1/4 W		OHMITE	RC07GF106J
R110	000102	RES	CARBON	1 K	5%	1/4 W		OHMITE	RC07GF102J
R111	000243	RES	CARBON	24 K	5%	1/4 W		OHMITE	RC07GF243J
R112	001102	RES	CARBON	9.1 K	5%	1/2 W		OHMITE	RC20GF912J
R113	000331	RES	CARBON	330 OHM	5%	1/4 W		OHMITE	RC07GF331J
R114	000272	RES	CARBON	2.7 K	5%	1/4 W		OHMITE	RC07GF272J
R115	000272	RES	CARBON	2.7 K	5%	1/4 W		OHMITE	RC07GF272J
R116	001731	RES	CARBON	6.8 OHM	5%	1/4 W		OHMITE	RC07GF6R8J
R117	000100	RES	CARBON	10 OHM	5%	1/4 W		OHMITE	RC07GF100J
R118	000272	RES	CARBON	2.7 K	5%	1/4 W		OHMITE	RC07GF272J
R119	000272	RES	CARBON	2.7 K	5%	1/4 W		OHMITE	RC07GF272J
R120	000153	RES	CARBON	15 K	5%	1/4 W		OHMITE	RC07GF153J
R121	000103	RES	CARBON	10 K	5%	1/4 W		OHMITE	RC07GF103J
R122	000103	RES	CARBON	10 K	5%	1/4 W		OHMITE	RC07GF103J
R123	000153	RES	CARBON	15 K	5%	1/4 W		OHMITE	RC07GF153J
R124	001102	RES	CARBON	9.1 K	5%	1/2 W		OHMITE	RC20GF912J
R125	000106	RES	CARBON	10 M	5%	1/4 W		OHMITE	RC07GF106J
R126	000103	RES	CARBON	10 K	5%	1/4 W		OHMITE	RC07GF103J

PARTS LIST

ASSEMBLY 403422 DMM MODEL 3800A A

REF. DESIG.	PART NO.	DESCRIPTION						
R127	000103	RES	CARBON	10 K	5%	1/4 W	OHMITE	RC07GF103J
R128	000103	RES	CARBON	10 K	5%	1/4 W	OHMITE	RC07GF103J
R129	000513	RES	CARBON	51 K	5%	1/4 W	OHMITE	RC07GF513J
R130	000272	RES	CARBON	2.7 K	5%	1/4 W	OHMITE	RC07GF272J
R131	000272	RES	CARBON	2.7 K	5%	1/4 W	OHMITE	RC07GF272J
R132	000272	RES	CARBON	2.7 K	5%	1/4 W	OHMITE	RC07GF272J
R133	000303	RES	CARBON	30 K	5%	1/4 W	OHMITE	RC07GF303J
R134	000303	RES	CARBON	30 K	5%	1/4 W	OHMITE	RC07GF303J
R135	000272	RES	CARBON	2.7 K	5%	1/4 W	OHMITE	RC07GF272J
R136	000272	RES	CARBON	2.7 K	5%	1/4 W	OHMITE	RC07GF272J
R137	000272	RES	CARBON	2.7 K	5%	1/4 W	OHMITE	RC07GF272J
R138	000272	RES	CARBON	2.7 K	5%	1/4 W	OHMITE	RC07GF272J
R139	000512	RES	CARBON	5.1 K	5%	1/4 W	OHMITE	RC07GF512J
R140	000512	RES	CARBON	5.1 K	5%	1/4 W	OHMITE	RC07GF512J
R141	000102	RES	CARBON	1 K	5%	1/4 W	OHMITE	RC07GF102J
R142	000103	RES	CARBON	10 K	5%	1/4 W	OHMITE	RC07GF103J
R143	000102	RES	CARBON	1 K	5%	1/4 W	OHMITE	RC07GF102J
R144	000512	RES	CARBON	5.1 K	5%	1/4 W	OHMITE	RC07GF512J
R145	000513	RES	CARBON	51 K	5%	1/4 W	OHMITE	RC07GF513J
R146	000513	RES	CARBON	51 K	5%	1/4 W	OHMITE	RC07GF513J
R147	000513	RES	CARBON	51 K	5%	1/4 W	OHMITE	RC07GF513J
R148	000224	RES	CARBON	220 K	5%	1/4 W	OHMITE	RC07GF224J
R149	000514	RES	CARBON	510 K	5%	1/4 W	OHMITE	RC07GF514J
R150	000514	RES	CARBON	510 K	5%	1/4 W	OHMITE	RC07GF514J
R151	000514	RES	CARBON	510 K	5%	1/4 W	OHMITE	RC07GF514J
R152	000514	RES	CARBON	510 K	5%	1/4 W	OHMITE	RC07GF514J
F01	920201	FUSE	GLASS	.2 A 250V			LITTLEFUSE	3AGE/10ASB
C39	101175	CAP	CERM	220 PFD	10%		AEROVOX	SCD1X5F
C45	120197	CAP	POLYS	20 PFD	1000 V		DUCATI	20-1000

PARTS LIST

ASSEMBLY 403315 DMM MODEL 3860A

A

REF. DESIG.	PART NO.	DESCRIPTION		
CR01	211083	DIODE SILICO 018	DANA	211083
CR02	220022	DIODE SILICO ZENER 1N965B	MOTOROLA	1N965B
CR13	220007	DIODE SILICO ZENER 1N751	MOTOROLA	1N751
CR14	220004	DIODE SILICO ZENER 1N961B	MOTOROLA	1N961B
CR15	211083	DIODE SILICO 018	DANA	211083
CR16	211083	DIODE SILICO 018	DANA	211083
CR17	211083	DIODE SILICO 018	DANA	211083
CR18	211083	DIODE SILICO 018	DANA	211083
CR19	220045	DIODE SILICO ZENER 1N827	SEMCOR	1N827
CR20	211083	DIODE SILICO 018	DANA	211083
CR21	220038	DIODE SILICO ZENER 1N959B	MOTOROLA	1N959B
CR22	211083	DIODE SILICO 018	DANA	211083
CR24	210004	DIODE SILICO SD4	DIODES IN	SD4
CR25	210004	DIODE SILICO SD4	DIODES IN	SD4
CR26	210004	DIODE SILICO SD4	DIODES IN	SD4
CR27	210004	DIODE SILICO SD4	DIODES IN	SD4
CR28	210004	DIODE SILICO SD4	DIODES IN	SD4
CR29	210004	DIODE SILICO SD4	DIODES IN	SD4
CR30	210004	DIODE SILICO SD4	DIODES IN	SD4
CR31	220012	DIODE SILICO ZENER 1N958B	MOTOROLA	1N958B
CR32	220012	DIODE SILICO ZENER 1N958B	MOTOROLA	1N958B
CR33	211083	DIODE SILICO 018	DANA	211083
CR34	211083	DIODE SILICO 018	DANA	211083
CR35	220029	DIODE SILICO ZENER 1N759A	MOTOROLA	1N759A
CR36	220038	DIODE SILICO ZENER 1N959B	MOTOROLA	1N959B
CR37	220004	DIODE SILICO ZENER 1N961B	MOTOROLA	1N961B
CR38	210004	DIODE SILICO SD4	DIODES IN	SD4
CR39	211083	DIODE SILICO 018	DANA	211083
CR40	210004	DIODE SILICO SD4	DIODES IN	SD4
CR41	211083	DIODE SILICO 018	DANA	211083
CR42	210004	DIODE SILICO SD4	DIODES IN	SD4
CR43	211083	DIODE SILICO 018	DANA	211083
CR44	220007	DIODE SILICO ZENER 1N751	MOTOROLA	1N751
C01	100017	CAP CERAM .01 MFD 200 V 10%	SPRAGUE	TH-S10
C20	120216	CAP MYLAR .068 MFD 200 V	CDE	WMF2S68
C21	120216	CAP MYLAR .068 MFD 200 V	CDE	WMF2S68
C22	120211	CAP MYLAR .033 MFD 200 V	CDE	WMF2S33
C24	111148	CAP ELECT 100 MFD 25 V 20%	SPRAGUE	TE1211
C25	120134	CAP MYLAR 1 MFD 200 V 10%	PAKTRON	MF1200LL

PARTS LIST

ASSEMBLY 403315 DMM MODEL 3860A A

REF. DESIG.	PART NO.	DESCRIPTION
C26	100017	CAP CERAM .01 MFD 200 V 10% SPRAGUE TH-S10
C27	110122	CAP 2.5 MFD 100 V IMB ZA28255J
C28	111148	CAP ELECT 100 MFD 25 V 20% SPRAGUE TE1211
C29	100017	CAP CERAM .01 MFD 200 V 10% SPRAGUE TH-S10
C30	110069	CAP ELEC 10 MFD 10 V KEMET K10W10K
C31	101174	CAP CERAM .001 MFD 500 V 10% AEROVOX SCD3X5F
C32	110121	CAP ELECT 2200 MFD 10 V AMPEREX ET222X010A03
C33	100017	CAP CERAM .01 MFD 200 V 10% SPRAGUE TH-S10
C34	110112	CAP ELECT 400 MFD 40 V AMPEREX C437ARG400
C35	110112	CAP ELECT 400 MFD 40 V AMPEREX C437ARG400
C36	101174	CAP CERAM .001 MFD 500 V 10% AEROVOX SCD3X5F
C37	101145	CAP CERAM 100 PFD 500 V 10% AEROVOX SCD1X5F
C38	101145	CAP CERAM 100 PFD 500 V 10% AEROVOX SCD1X5F
C39	101175	CAP CERAM 220 PFD 500 V 10% AEROVOX SCD1X5F
C40	101174	CAP CERAM .001 MFD 500 V 10% AEROVOX SCD3X5F
C41	101644	CAP CERAM 200 PFD 500 V 20% AEROVOX GPDX5F201K
C42	101644	CAP CERAM 200 PFD 500 V 20% AEROVOX GPDX5F201K
C43	101175	CAP CERAM 220 PFD 500 V 10% AEROVOX SCD1X5F
M01	230014	INTEGRATED CIRCUIT UL9960 FAIRCHILD UL9960
M02	230049	INTEGRATED CIRCUIT CUL9958 FAIRCHILD CUL9958
M03	230014	INTEGRATED CIRCUIT UL9960 FAIRCHILD UL9960
M04	230049	INTEGRATED CIRCUIT CUL9958 FAIRCHILD CUL9958
M05	230014	INTEGRATED CIRCUIT UL9960 FAIRCHILD UL9960
M06	230049	INTEGRATED CIRCUIT CUL9958 FAIRCHILD CUL9958
M07	230058	INTEGRATED CIRCUIT MC722P MOTOROLA MC722P
M08	230002	INTERGRATED CIRCUIT MC717 MOTOROLA MC717
M09	230057	INTEGRATED CIRCUIT MC9718P MOTOROLA MC9718P
M10	230002	INTERGRATED CIRCUIT MC717 MOTOROLA MC717
M11	230045	INTEGRATED CIRCUIT UA741C FAIRCHILD UA741C
Q01	200112	TRANS SILICO DUAL FSV DANA 200112
Q02	200112	TRANS SILICO DUAL FSV DANA 200112
Q03	200088	TRANS SILICO PNP 2N4248 FAIRCHILD 2N4248
Q04	200043	TRANS SILICO NPN 2N3565 FAIRCHILD 2N3565
Q05	200088	TRANS SILICO PNP 2N4248 FAIRCHILD 2N4248
Q06	200043	TRANS SILICO NPN 2N3565 FAIRCHILD 2N3565
Q07	200043	TRANS SILICO NPN 2N3565 FAIRCHILD 2N3565
Q08	200088	TRANS SILICO PNP 2N4248 FAIRCHILD 2N4248

PARTS LIST

ASSEMBLY 403315 DMM MODEL 3860A

A

REF. DESIG.	PART NO.	DESCRIPTION		
Q09	200043	TRANS SILICO NPN	2N3565	FAIRCHILD 2N3565
Q15	200136	TRANS	SE4022	FAIRCHILD SE4022
Q16	200043	TRANS SILICO NPN	2N3565	FAIRCHILD 2N3565
Q17	200135	TRANS SILICO SELECTED		DANA 200135
Q18	200043	TRANS SILICO NPN	2N3565	FAIRCHILD 2N3565
Q19	200037	TRANS SILICO NPN	2N3646	FAIRCHILD 2N3646
Q20	200136	TRANS	SE4022	FAIRCHILD SE4022
Q21	200043	TRANS SILICO NPN	2N3565	FAIRCHILD 2N3565
Q22	200044	TRANS SILICO NPN DUAL	FSV	DANA 200044
Q23	200088	TRANS SILICO PNP	2N4248	FAIRCHILD 2N4248
Q24	200044	TRANS SILICO NPN DUAL	FSV	DANA 200044
Q25	200037	TRANS SILICO NPN	2N3646	FAIRCHILD 2N3646
Q26	200037	TRANS SILICO NPN	2N3646	FAIRCHILD 2N3646
Q27	200068	TRANS	2N4250	FAIRCHILD 2N4250
Q28	200043	TRANS SILICO NPN	2N3565	FAIRCHILD 2N3565
Q29	200107	TRANS SILICO	2N4302	INTERSIL 2N4302
Q30	200088	TRANS SILICO PNP	2N4248	FAIRCHILD 2N4248
Q31	200037	TRANS SILICO NPN	2N3646	FAIRCHILD 2N3646
Q32	200075	TRANS	2N4870	MOTOROLA 2N4870
Q33	200043	TRANS SILICO NPN	2N3565	FAIRCHILD 2N3565
Q34	200111	TRANS SILICO	MPSU02	MOTOROLA MPSU02
Q35	200129	TRANS SILICO	SE4020	FAIRCHILD SE4020
Q36	200035	TRANS SILICO NPN	014	DANA 200035
Q37	200043	TRANS SILICO NPN	2N3565	FAIRCHILD 2N3565
Q38	200043	TRANS SILICO NPN	2N3565	FAIRCHILD 2N3565
Q39	200088	TRANS SILICO PNP	2N4248	FAIRCHILD 2N4248
Q40	200011	TRANS SILICO PNP	009	DANA 200011
Q41	200088	TRANS SILICO PNP	2N4248	FAIRCHILD 2N4248
Q42	200159	TRANS		DANA 200159
Q43	200159	TRANS		DANA 200159
Q44	200159	TRANS		DANA 200159
Q45	200159	TRANS		DANA 200159
Q46	200037	TRANS SILICO NPN	2N3646	FAIRCHILD 2N3646
Q47	200037	TRANS SILICO NPN	2N3646	FAIRCHILD 2N3646
Q48	200037	TRANS SILICO NPN	2N3646	FAIRCHILD 2N3646
Q49	200037	TRANS SILICO NPN	2N3646	FAIRCHILD 2N3646
Q50	200048	TRANS SILICO NPN DUAL	2N3565	DANA 200048
Q51	200048	TRANS SILICO NPN DUAL	2N3565	DANA 200048
R01	010484	RES METAL	8.975 MEG 1%	IRC RN80C

PARTS LIST

ASSEMBLY 403315 DMM MODEL 3860A A

REF. DESIG.	PART NO.	DESCRIPTION					
R02	040172	RES VARI	50 K			SPECTROL	41-2-1-503
R03	010485	RES METAL	872.5 K	1%		IRC	RN65C
R04	040173	RES VARI	5 K			SPECTROL	41-2-1-502
R05	010486	RES METAL	87.25 K	1%		IRC	RN55C
R06	040174	RES VARI	500 OHM			SPECTROL	41-2-1-501
R07	020562	RES WW	8.725 K	1%	2 W	C-F M19	
R08	040176	RES VARI	50 OHM			SPECTROL	41-2-1-500
R09	020563	RES WW	975 OHMS	1%	2 W	C-F M19	
R10	040169	RES VARI	20 OHM	20%	.75 W	SPECTROL	41-2-1-200
R11	020575	RES WW	210 OHM	1%	2 W	C-F M19	
R12	020572	RES WW	2 K	1%		C-F M19	
R13	000103	RES CARBON	10 K	5%	1/4 W	OHMITE	RC07GF103J
R14	000475	RES CARBON	4.7 M	5%	1/4 W	OHMITE	RC07GF475J
R15	000206	RES CARBON	20 M	5%	1/4 W	OHMITE	RC07GF206J
R16	010488	RES METAL	12.4 K	1%		IRC	RN55E
R17	040112	RES VARI	2 K			BECKMAN	79PR2K
R18	010492	RES METAL	6.81 K	1%		IRC	RN55E
R19	040174	RES VARI	500 OHM			SPECTROL	41-2-1-501
R20	010493	RES METAL	1.74 K	1%		IRC	RN55E
R21	000622	RES CARBON	6.2 K	5%	1/4 W	OHMITE	RC07GF622J
R22	000223	RES CARBON	22 K	5%	1/4 W	OHMITE	RC07GF223J
R23	000102	RES CARBON	1 K	5%	1/4 W	OHMITE	RC07GF102J
R24	000113	RES CARBON	11 K	5%	1/4 W	OHMITE	RC07GF113J
R25	010490	RES METAL	10 K	1%		IRC	RN55E
R26	010490	RES METAL	10 K	1%		IRC	RN55E
R27	000511	RES CARBON	510 OHM	5%	1/4 W	OHMITE	RC07GF511J
R53	001762	RES CARBON	1 MEG	5%	1 W	OHMITE	RC32GF105J
R54	000514	RES CARBON	510 K	5%	1/4 W	OHMITE	RC07GF524J
R55	000622	RES CARBON	6.2 K	5%	1/4 W	OHMITE	RC07GF622J
R56	000204	RES CARBON	200 K	5%	1/4 W	OHMITE	RC07GF204J
R57	000514	RES CARBON	510 K	5%	1/4 W	OHMITE	RC07GF524J
R58	000624	RES CARBON	620 K	5%	1/4 W	OHMITE	RC07GF624J
R59	000103	RES CARBON	10 K	5%	1/4 W	OHMITE	RC07GF103J
R60	000183	RES CARBON	18 K	5%	1/4 W	OHMITE	RC07GF183J
R61	000222	RES CARBON	2.2 K	5%	1/4 W	OHMITE	RC07GF222J
R62	020566	RES WW	36 K	1%		C-F F155	
R63	200135	TRANS SILICO	SELECTED			DANA	200135
R64	000222	RES CARBON	2.2 K	5%	1/4 W	OHMITE	RC07GF222J
R65	000183	RES CARBON	18 K	5%	1/4 W	OHMITE	RC07GF183J

PARTS LIST

ASSEMBLY 403315 DMM MODEL 3860A A

REF. DESIG.	PART NO.	DESCRIPTION							
R67	000272	RES	CARBON	2.7 K	5%	1/4 W		OHMITE	RC07GF272J
R68	200135	TRANS SILICO		SELECTED				DANA	200135
R69	020566	RES WW		36 K	1%			C-F F155	
R70	000113	RES	CARBON	11 K	5%	1/4 W		OHMITE	RC07GF113J
R71	000202	RES	CARBON	2 K	5%	1/4 W		OHMITE	RC07GF202J
R72	000272	RES	CARBON	2.7 K	5%	1/4 W		OHMITE	RC07GF272J
R73	000202	RES	CARBON	2 K	5%	1/4 W		OHMITE	RC07GF202J
R74	000513	RES	CARBON	51 K	5%	1/4 W		OHMITE	RC07GF513J
R75	000512	RES	CARBON	5.1 K	5%	1/4 W		OHMITE	RC07GF512J
R76	000105	RES	CARBON	1 M	5%	1/4 W		OHMITE	RC07GF105J
R77	020580	RES WW		10 K	1%	2 W		C-F M19	
R78	040174	RES	VARI	500 OHM				SPECTROL	41-2-1-501
R79	020580	RES WW		10 K	1%	2 W		C-F M19	
R80	000104	RES	CARBON	100 K	5%	1/4 W		OHMITE	RC07GF104J
R81	000516	RES	CARBON	51 M	5%	1/4 W		OHMITE	RC07GF516J
R82	000272	RES	CARBON	2.7 K	5%	1/4 W		OHMITE	RC07GF272J
R83	000272	RES	CARBON	2.7 K	5%	1/4 W		OHMITE	RC07GF272J
R84	000513	RES	CARBON	51 K	5%	1/4 W		OHMITE	RC07GF513J
R85	040112	RES	VARI	2 K				BECKMAN	79PR2K
R86	020574	RES WW		11.5 K	1%	2 W		C-F M19	
R87	000107	RES	CARBON	100 M	5%	1/4 W		OHMITE	RC07GF107J
R88	000123	RES	CARBON	12 K	5%	1/4 W		OHMITE	RC07GF123J
R89	010555	RES	METAL	1.82 K	1%			IRC	RN55C
R90	000203	RES	CARBON	20 K	5%	1/4 W		OHMITE	RC07GF203J
R91	000105	RES	CARBON	1 M	5%	1/4 W		OHMITE	RC07GF105J
R92	000272	RES	CARBON	2.7 K	5%	1/4 W		OHMITE	RC07GF272J
R93	000512	RES	CARBON	5.1 K	5%	1/4 W		OHMITE	RC07GF512J
R94	000272	RES	CARBON	2.7 K	5%	1/4 W		OHMITE	RC07GF272J
R95	000622	RES	CARBON	6.2 K	5%	1/4 W		OHMITE	RC07GF622J
R96	000272	RES	CARBON	2.7 K	5%	1/4 W		OHMITE	RC07GF272J
R97	000272	RES	CARBON	2.7 K	5%	1/4 W		OHMITE	RC07GF272J
R98	000104	RES	CARBON	100 K	5%	1/4 W		OHMITE	RC07GF104J
R99	000106	RES	CARBON	10 M	5%	1/4 W		OHMITE	RC07GF106J
R100	000512	RES	CARBON	5.1 K	5%	1/4 W		OHMITE	RC07GF512J
R101	000203	RES	CARBON	20 K	5%	1/4 W		OHMITE	RC07GF203J
R102	000511	RES	CARBON	510 OHM	5%	1/4 W		OHMITE	RC07GF511J
R103	000101	RES	CARBON	100 OHM	5%	1/4 W		OHMITE	RC07GF101J

PARTS LIST

ASSEMBLY 403315 DMM MODEL 3860A A

REF. DESIG.	PART NO.	DESCRIPTION							
R104	001102	RES	CARBON	9.1	K	5%	1/2	W	OHMITE	RC20GF912J
R105	000472	RES	CARBON	4.7	K	5%	1/4	W	OHMITE	RC07GF472J
R106	000104	RES	CARBON	100	K	5%	1/4	W	OHMITE	RC07GF104J
R107	000103	RES	CARBON	10	K	5%	1/4	W	OHMITE	RC07GF103J
R108	000133	RES	CARBON	13	K	5%	1/4	W	OHMITE	RC07GF133J
R109	000106	RES	CARBON	10	M	5%	1/4	W	OHMITE	RC07GF106J
R110	000102	RES	CARBON	1	K	5%	1/4	W	OHMITE	RC07GF102J
R111	000243	RES	CARBON	24	K	5%	1/4	W	OHMITE	RC07GF243J
R112	001102	RES	CARBON	9.1	K	5%	1/2	W	OHMITE	RC20GF912J
R113	000331	RES	CARBON	330	OHM	5%	1/4	W	OHMITE	RC07GF331J
R114	000272	RES	CARBON	2.7	K	5%	1/4	W	OHMITE	RC07GF272J
R115	000272	RES	CARBON	2.7	K	5%	1/4	W	OHMITE	RC07GF272J
R116	001731	RES	CARBON	6.8	OHM	5%	1/4	W	OHMITE	RC07GF6R8U
R117	000100	RES	CARBON	10	OHM	5%	1/4	W	OHMITE	RC07GF100J
R118	000272	RES	CARBON	2.7	K	5%	1/4	W	OHMITE	RC07GF272J
R119	000272	RES	CARBON	2.7	K	5%	1/4	W	OHMITE	RC07GF272J
R120	000153	RES	CARBON	15	K	5%	1/4	W	OHMITE	RC07GF153J
R121	000103	RES	CARBON	10	K	5%	1/4	W	OHMITE	RC07GF103J
R122	000103	RES	CARBON	10	K	5%	1/4	W	OHMITE	RC07GF103J
R123	000153	RES	CARBON	15	K	5%	1/4	W	OHMITE	RC07GF153J
R124	001102	RES	CARBON	9.1	K	5%	1/2	W	OHMITE	RC20GF912J
R125	000106	RES	CARBON	10	M	5%	1/4	W	OHMITE	RC07GF106J
R126	000103	RES	CARBON	10	K	5%	1/4	W	OHMITE	RC07GF103J
R127	000103	RES	CARBON	10	K	5%	1/4	W	OHMITE	RC07GF103J
R128	000103	RES	CARBON	10	K	5%	1/4	W	OHMITE	RC07GF103J
R129	000513	RES	CARBON	51	K	5%	1/4	W	OHMITE	RC07GF513J
R130	000272	RES	CARBON	2.7	K	5%	1/4	W	OHMITE	RC07GF272J
R131	000272	RES	CARBON	2.7	K	5%	1/4	W	OHMITE	RC07GF272J
R132	000272	RES	CARBON	2.7	K	5%	1/4	W	OHMITE	RC07GF272J
R133	000303	RES	CARBON	30	K	5%	1/4	W	OHMITE	RC07GF303J
R134	000303	RES	CARBON	30	K	5%	1/4	W	OHMITE	RC07GF303J
R135	000272	RES	CARBON	2.7	K	5%	1/4	W	OHMITE	RC07GF272J
R136	000272	RES	CARBON	2.7	K	5%	1/4	W	OHMITE	RC07GF272J
R137	000272	RES	CARBON	2.7	K	5%	1/4	W	OHMITE	RC07GF272J
R138	000272	RES	CARBON	2.7	K	5%	1/4	W	OHMITE	RC07GF272J
R139	000512	RES	CARBON	5.1	K	5%	1/4	W	OHMITE	RC07GF512J
R140	000512	RES	CARBON	5.1	K	5%	1/4	W	OHMITE	RC07GF512J
R141	000102	RES	CARBON	1	K	5%	1/4	W	OHMITE	RC07GF102J
R142	000103	RES	CARBON	10	K	5%	1/4	W	OHMITE	RC07GF103J

PARTS LIST

ASSEMBLY 403315 DMM MODEL 3860A A

REF. DESIG.	PART NO.	DESCRIPTION							
R143	000102	RES	CARBON	1 K	5%	1/4 W		OHMITE	RC07GF102J
R144	000513	RES	CARBON	51 K	5%	1/4 W		OHMITE	RC07GF513J
R145	000513	RES	CARBON	51 K	5%	1/4 W		OHMITE	RC07GF513J
R146	000513	RES	CARBON	51 K	5%	1/4 W		OHMITE	RC07GF513J
R147	000224	RES	CARBON	220 K	5%	1/4 W		OHMITE	RC07GF224J
R148	000514	RES	CARBON	510 K	5%	1/4 W		OHMITE	RC07GF524J
R149	000514	RES	CARBON	510 K	5%	1/4 W		OHMITE	RC07GF524J
R150	000514	RES	CARBON	510 K	5%	1/4 W		OHMITE	RC07GF524J
R151	000514	RES	CARBON	510 K	5%	1/4 W		OHMITE	RC07GF524J
F01	920201	FUSE	GLASS	.2 A 250V				LITTLEFUSE	3AGE/10ASB
TP01	600245	JUMPER						GETTIG	
TP02	600245	JUMPER						GETTIG	
TP03	600245	JUMPER						GETTIG	
S01	600526	SWITCH ROTARY						CTS	215

PARTS LIST

ASSEMBLY 403339 – Model 3800A/3860A

REF DES	PART NO.	DESCRIPTION				
DS01	920465	LAMP	NEON		SIGNALITE	A-261
DS02	920116	LAMP	NEON	NE-2H	GE	MPG250-3
DS03	920116	LAMP	NEON	NE-2H	GE	MPG250-3
DS04	920116	LAMP	NEON	NE-2H	GE	MPG250-3

PARTS LIST

ASSEMBLY 403337 – Model 3800A/3860A

REF DES	PART NO.	DESCRIPTION						
C01	121088	CAP	MYLAR	.01 MFD	100 V	10%	CDE	WMF1S1
C02	121093	CAP	MYLAR	.047 MFD	100 V	10%	CDE	WMF1S47
C03	101641	CAP	CERAM	470 PFD	500 V	10%	AEROVOX	SCD1X5F
CR01	210004	DIODE	SILICO	SD4			DIODES IN SD4	
CR02	210004	DIODE	SILICO	SD4			DIODES IN SD4	
CR03	210004	DIODE	SILICO	SD4			DIODES IN SD4	
CR04	211083	DIODE	SILICO	018			DANA	211083
CR05	211083	DIODE	SILICO	018			DANA	211083
CR06	211083	DIODE	SILICO	018			DANA	211083
M01	230057	INTEGRATED CIRCUIT			MC9718P		MOTOROLA	MC9718P
M02	230057	INTEGRATED CIRCUIT			MC9718P		MOTOROLA	MC9718P
M03	230057	INTEGRATED CIRCUIT			MC9718P		MOTOROLA	MC9718P
M04	230002	INTEGRATED CIRCUIT			MC717		MOTOROLA	MC717
Q01	200037	TRANS	SILICO	NPN	2N3646		FAIRCHILD	2N3646
Q02	200037	TRANS	SILICO	NPN	2N3646		FAIRCHILD	2N3646
Q03	200037	TRANS	SILICO	NPN	2N3646		FAIRCHILD	2N3646
Q04	200037	TRANS	SILICO	NPN	2N3646		FAIRCHILD	2N3646
R12	000302	RES	CARBON	3 K		5% 1/4W	OHMITE	RC07GF302J
R13	000302	RES	CARBON	3 K		5% 1/4W	OHMITE	RC07GF302J
R14	000302	RES	CARBON	3 K		5% 1/4W	OHMITE	RC07GF302J
R15	000302	RES	CARBON	3 K		5% 1/4W	OHMITE	RC07GF302J
R16	000302	RES	CARBON	3 K		5% 1/4W	OHMITE	RC07GF302J
R17	000302	RES	CARBON	3 K		5% 1/4W	OHMITE	RC07GF302J
R18	000302	RES	CARBON	3 K		5% 1/4W	OHMITE	RC07GF302J
R19	000512	RES	CARBON	5.1 K		5% 1/4W	OHMITE	RC07GF512J
R20	000512	RES	CARBON	5.1 K		5% 1/4W	OHMITE	RC07GF512J
R21	000103	RES	CARBON	10 K		5% 1/4W	OHMITE	RC07GF103J
R22	000512	RES	CARBON	5.1 K		5% 1/4W	OHMITE	RC07GF512J
R23	000302	RES	CARBON	3 K		5% 1/4W	OHMITE	RC07GF302J

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